OPERATIVE SURGERY

UNDER THE GENERAL EDITORSHIP OF

CHARLES ROB, M C

M CHIR., F.R.C.S

Professor of Surgery, St Mary's Hospital, London

and

RODNEY SMITH

M.S., F R.C.S

Surgeon, St George's Hospital, London

VOLUME FOUR

HEAD AND NECK AND CLEARANCE
OF LYMPH NODES
VASCULAR SURGERY
ENDOCRINE GLANDS

LONDON

BUTTERWORTH & CO (PUBLISHERS) LTD

1957

AFRICA BUTTERWORTH & CO (AFRICA) LTD
DURBAN 88/80 BEACH GROVE

AUSTRALIA. BUTTERWORTH & CO (AUSTRALIA) LTD.
SYDNEY 8 O CONNELL STREET
MELBOURNE 430 BOURKE STREET
BRISBANE 240 QUEEN STREET

CANADA. BUTTERWORTH & CO (CANADA) LTD
TORONTO 1367 DANFORTH AVENUE

NEW ZEALAND BUTTERWORTH & CO (AUSTRALIA) LTD
WELLINGTON 49/51 BALLANCE STREET
AUCKLAND 35 HIGH STREET

MADE AND PRINTED IN GREAT BRITAIN
AT THE CHAPEL RIVER PRESS
ANDOVER, HANTS

CONSULTANT AND ASSOCIATE EDITORS

CONTRIBUTORS TO THIS VOLUME

JAMES BULL, M D F R C P F F R
Radiologist St George's Hospital London Radiologist National Hospitals for Nervous Diseases

F B COCKETT M S F R.C S
Surgeon St Thomas's Hospital, London

H H G EASTCOTT M S F R.C S
Surgeon St Mary's Hospital London

M R. EWING M B CH.B F R.C S
Professor of Surgery University of Melbourne

B W FICKLING F.R C S., F D S (ENG)
Senior Dental Surgeon St George's Hospital London, Dental Surgeon Royal Dental Hospital of London School of Dental Surgery Senior Dental Surgeon The Mount Vernon Centre for Plastic and Jaw Surgery, Northwood

W P GREENING F R.C S
Surgeon The Royal Marsden Hospital London Surgeon Charing Cross Hospital, London

R. P JEPSON F R C.S
Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

JOSEPHUS C LUKE, M.B.E M.D F.A.C S., F R C S (ENG) and (C.)
Assistant Professor of Surgery McGill University Montreal Associate Surgeon Royal Victoria Hospital Montreal Consulting Surgeon Queen Mary Veterans Hospital Montreal

GEORGE A. MASON V R.D F R.C S
Lecturer in Thoracic Surgery King's College University of Durham Newcastle-upon-Tyne

R. MOWLEM F R.C.S
Surgeon-in-Charge Plastic Department Middlesex Hospital London Surgeon-in-Charge Centre for Plastic Surgery Mount Vernon Hospital Northwood

R W NEVIN T D M.B F R.C S
Surgeon St Thomas's Hospital London

K. OWEN M.B B S F.R.C S
Assistant Director Surgical Unit St Mary's Hospital London

DAVID H. PATEY M.S F R.C S
Surgeon Middlesex Hospital London

J N PATTINSON M.B D R.M.D F F.R.
Radiologist Middlesex Hospital London

J SETON PRINGLE, F.R.C.S (I.) and (ENG)
Professor of Surgery Royal College of Surgeons in Ireland

CONTRIBUTORS TO THIS VOLUME

RONALD W RAVEN O.B.E. T.D , F.R.C.S
Surgeon Westminster (Gordon) Hospital London Surgeon The Royal Marsden Hospital London

CHARLES ROB, *M C* M.CHIR. F R C.S
Professor of Surgery St Mary s Hospital London

JOHN F SIMPSON F R.C S
Surgeon Ear Nose and Throat Department St Mary s Hospital London

B McN TRUSCOTT M B E., M A. M B F R.C S
Surgeon to the United Cambridge Hospitals

E. G TUCKWELL, M CH., F.R C S
Surgeon St Bartholomew s Hospital London Dean St Bartholomew s Hospital London Dean St. Bartholomew s Hospital Medical School

G K. TUTTON CH.M F R.C.S
University Lecturer in Neurosurgery Manchester Royal Infirmary

CONTENTS

PART VI HEAD AND NECK AND CLEARANCE OF LYMPH NODES

Section I Head — PAGE

EXCISION OF SEBACEOUS CYST - - - - - 5
K. Owen M B B S F R.C S

EXCISION OF SUBCUTANEOUS DERMOID CYST - - 8
K. Owen M B B S F R C S

EXCISION OF PINNA - - - - - - - 11
K. Owen M B B S., F R C S

EXCISION OF OSTEOMA OF VAULT OF THE SKULL - 14
K. Owen M B B S F R C.S

Section II Neck

SURGICAL TREATMENT OF TUBERCULOUS CERVICAL LYMPH NODES - - - - - - 18
M R. Ewing M.B Ch.B F R.C S

INCISION OF ACUTE CERVICAL ABSCESS - - - 24
M R. Ewing M B Ch.B F R.C.S

REMOVAL OF CYSTIC HYGROMA - - - - 26
B McN Truscott M B.E. M.A. M B F.R.C S

REMOVAL OF SUBMENTAL DERMOID CYST - - - 30
B McN Truscott M.B.E. M A., M B F.R C S

BRANCHIAL CYST AND CERVICAL SINUS - - - 34
B McN Truscott M.B.E M A M B F R C S

CAROTID BODY TUMOUR - - - - - 39
B McN Truscott M.B E M.A. M.B, F R C S

EXCISION OF PHARYNGEAL POUCH - - - 43
B McN Truscott M B E. M.A M.B F R.C S

TRACHEOSTOMY - - - - - - 49
B McN Truscott M.B E. M A M.B F R.C S

OPERATION FOR CERVICAL RIB - - - - 54
B McN Truscott M.B E. M A M.B F R C S

PAGE

CARCINOMA OF THE PHARYNX - - - - - 59
RONALD W RAVEN O.B E., T D., F.R.C.S

BLOCK DISSECTION OF CERVICAL LYMPH NODES - - 72
M R. EWING M.B CH.B F R.C.S

Section III Clearance of Lymph Nodes

EXCISION OF AXILLARY AND INGUINAL LYMPH NODES - 85
R. W NEVIN T D M B., F R.C.S

Section IV Face, Jaws and Mouth

EXCISION OF THE MAXILLA INCLUDING PALATAL FENESTRATION - - - - - - - 94
JOHN F SIMPSON F R.C.S

EXCISION OF THE MANDIBLE - - - - - 108
JOHN F SIMPSON F R.C.S

CARCINOMA OF THE TONGUE AND MOUTH - - 117
RONALD W RAVEN O B.E., T D F R.C.S

EPITHELIOMA OF THE LIP - - - - - - 128
RONALD W RAVEN O.B.E., T.D., F.R.C.S

SIALOGRAPHY - - - - - - - - 131
J N PATTINSON M.B D R. M D., F F.R.

OPERATIONS ON THE PAROTID GLAND - - - 135
DAVID H. PATEY M S F R C.S

INTRA-ORAL REMOVAL OF SUBMANDIBULAR DUCT CALCULUS - - - - - - - - 147
DAVID H. PATEY M.S., F.R.C.S

EXCISION OF SUBMANDIBULAR GLAND - - - 149
DAVID H. PATEY M.S., F.R.C.S

INNOCENT TUMOURS OF THE TONGUE AND FLOOR OF MOUTH - - - - - - - - 152
RONALD W RAVEN O B.E., T.D F R.C.S

DENTAL CYSTS AND TUMOURS - - - - 156
B W FICKLING F R.C S F.D S (ENG)

PART VII VASCULAR SURGERY

Section I Sympathetic Nervous System PAGE

SYMPATHETIC GANGLION BLOCK - - - - 5
CHARLES ROB M.C M CHIR. F R.C.S and E G TUCKWELL, M.CH. F R.C S

PAGE

TREATMENT OF ARTERIAL ANEURYSMS - - - 115
CHARLES ROB MC M.CHIR., F R.C S

ARTERIO-VENOUS FISTULAS - - - - - 127
H H G EASTCOTT M S., F R.C S

THROMBO-ENDARTERECTOMY - - - - 133
H H. G EASTCOTT M S F R.C S

Section IV Operations for Lymphoedema

EXCISION OF SUBCUTANEOUS TISSUES FOR LYMPHOEDEMA 138
R. MOWLEM F R.C S

Section V Other Procedures for Peripheral Vascular Occlusion

ACHILLES TENOTOMY - - - - - 142
R. P JEPSON F R.C.S

PART VIII ENDOCRINE GLANDS

Section I Thyroid Gland PAGE

SUBTOTAL THYROIDECTOMY - - - - 5
CHARLES ROB, MC., M CHIR., F R.C.S

RADICAL THYROIDECTOMY - - - - - 13
CHARLES ROB M.C M CHIR., F R.C S

HEMITHYROIDECTOMY RESECTION ENUCLEATION AND CERVICAL APPROACH TO RETROSTERNAL GOITRE - 18
CHARLES ROB MC M CHIR F R C S

EXCISION OF LINGUAL THYROID AND THYROGLOSSAL CYST OR SINUS - - - - - - 22
CHARLES ROB M.C M CHIR. F R.C S

Section II Parathyroid Glands

EXPLORATION OF THE PARATHYROID GLANDS - - 27
CHARLES ROB, M.C M CHIR F R C.S

Section III Thymus Gland

THYMECTOMY - - - - - 32
GEORGE A MASON V R D F R.C.S

Section IV Pituitary Gland PAGE

EXPOSURE OF THE PITUITARY REGION BY THE FRONTAL APPROACH - - - - - - - - 39
G K. TUTTON, CH M F R C S

INTERSTITIAL IRRADIATION OF PITUITARY - - - 47
W P GREENING F R C.S

Section V Adrenal Gland

EXPOSURE AND RESECTION OF ADRENAL GLAND FOR TUMOUR TRANSDIAPHRAGMATIC APPROACH - - 51
J SETON PRINGLE, F R.C S (I) and (ENG)

SUBTOTAL ADRENALECTOMY ABDOMINAL APPROACH - 57
J SETON PRINGLE, F R C.S (I) and (ENG)

TOTAL ADRENALECTOMY USING LUMBAR INCISIONS - 63
J SETON PRINGLE, F R.C S (I) and (ENG)

INDEX

PART VI

HEAD AND NECK AND CLEARANCE OF LYMPH NODES

PART VI HEAD AND NECK AND CLEAR/ OF LYMPH NODES

Section I Head Page

Excision of sebaceous cyst 5
Excision of subcutaneous dermoid cyst 8
Excision of pinna 11
Excision of osteoma of vault of the skull 14

Section II Neck

Surgical treatment of tuberculous cervical lymph nodes 18
EVACUATION OF COLD ABSCESS
Incision of acute cervical abscess 24
Removal of cystic hygroma 26
Removal of submental dermoid cyst 30
Branchial cyst and cervical sinus 34
Carotid body tumour 39
Excision of pharyngeal pouch 43
Tracheostomy 49
Operation for cervical rib 54
Carcinoma of the pharynx 59
CARCINOMA OF THE OROPHARYNX
CARCINOMA OF THE HYPOPHARYNX
Block dissection of cervical lymph nodes 72

Section III Clearance of Lymph Nodes

Excision of axillary and inguinal lymph nodes 85

Section IV Face, Jaws and Mouth

Excision of the maxilla including palatal fenestration 94
Excision of the mandible 108

Carcinoma of the tongue and mouth
PARTIAL GLOSSECTOMY
HEMI-GLOSSECTOMY
TOTAL GLOSSECTOMY
GLOSSECTOMY AND EXCISION OF THE FLOOR MOUTH
EXCISION OF THE TONGUE, FLOOR OF THE MO THE MANDIBLE
Epithelioma of the lip
WEDGE EXCISION
EXTENSIVE RESECTION
PARTIAL RESECTION OF LIP AND JAW
Sialography
PAROTID SIALOGRAM
SUBMANDIBULAR SIALOGRAM
Operations on the parotid gland
CONSERVATIVE PAROTIDECTOMY
RADICAL PAROTIDECTOMY
ENLARGEMENT OF THE PAROTID DUCT ORIFICE
DRAINAGE OF PAROTID ABSCESS
Intra-oral removal of submandibular duct
Excision of submandibular gland
Innocent tumours of the tongue and f mouth
EXCISION OF SEQUESTRATION DERMOID CYST IN MOUTH
TUBERO-DERMOID CYST IN THE POSTERIOR PART TONGUE
PAPILLOMA
Dental cysts and tumours
SIMPLE EXCISION OF PERIPHERAL TUMOURS
ENUCLEATION OF ENCAPSULATED CENTRAL TUMOU
MARSUPIALIZATION OF THE LARGER CYSTIC CAVIT
SUBPERIOSTEAL EXCISION OF LOCALLY INVASIVE AND DYSPLASIAS

For Head trauma *see* Part II SURGERY OF TRAUMA
Operation on the oesophagus *see* Part V THORAX
E.N.T. surgery *see* Part XVIII EAR, NOSE AND THROAT

EXCISION OF SEBACEOUS CYST

K Owen M B., B S., F R C.S

Assistant Director Surgical Unit St Mary s Hospital London

PRE-OPERATIVE

A sebaceous cyst is a retention cyst of a sebaceous gland the contents of the cyst being sebum and desquam epithelium Occasionally keratin is found in the cyst instead of the usual sebaceous material Broders and W (1930) have suggested that these are true tumours arising from the ducts of the sebaceous glands and have re mended that these be more accurately named keratomas. Sebaceous cysts occur most commonly on the face and may be single or multiple as many as 20-30 cysts being found on occasion They vary in size from millimetres in diameter to many centimetres They are usually excised for cosmetic reasons or because of attacks of infection A cyst may become infected with staphylococci or less commonly streptococci This may be minimal giving slight redness and tenderness which resolve rapidly with chemotherapy or it may p to an abscess rarely a spreading cellulitis may be produced. The cyst may undergo malignant degeneration risk of this change has probably been exaggerated by some authors Caylor (1925) for example, gives the of malignant change as 8 44 per cent. This is obviously a far higher figure than the common experience in Britain and it is possibly due to selection of cases Caylor s cases were reported from the Mayo Clinic probable that such a series contained a high proportion of suspicious tumours referred from the district.

Recurrence following removal of cyst

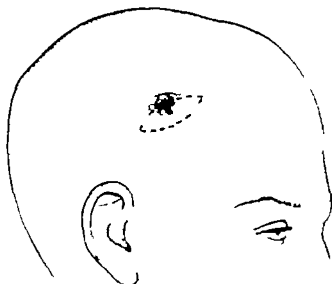
If the cyst wall is not removed completely there is a considerable chance of recurrence. Treatment by trans of the sac and avulsion of the lining membrane carries an obvious risk of leaving fragments of the cyst is therefore not recommended. An acute infection in a sebaceous cyst should be treated with a course of penicillin followed by excision of the cyst several weeks later Should an abscess develop despite chemotherap treated by incision the remains of the cyst being excised after this incision has healed.

Preparation

A limited shaving of the scalp is performed and the skin is prepared with iodine The remaining hair area of dissection may be held in place with a towel or bandage or may be greased lightly with liquid par surgical lubricant and combed away from the cyst.

Anaesthesia

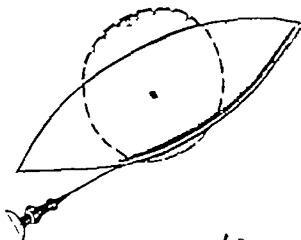
Local anaesthesia is suitable for most cases 1 per cent lignocaine with adrenaline (1 100 000) being used, being infiltrated as an intra-dermal wheal If a number of cysts are to be excised then a general anaesthetic is comfortable



THE OPERATION

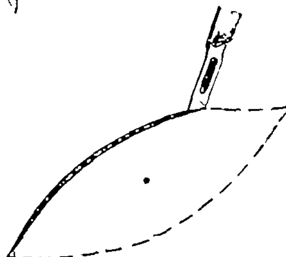
Line of incision

This is an ellipse enclosing the punctum of the cyst. Its axis should be in the line of adjacent skin creases so as to produce the best cosmetic scar



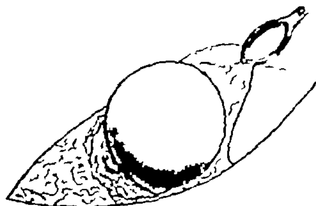
Infiltration of anaesthetic

The local anaesthetic is injected as an intradermal wheal along the line of incision and a further small injection is made more deeply around the cyst.



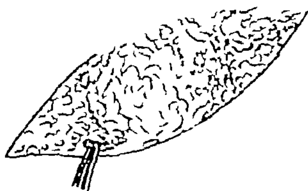
Skin incision

The incision is made through skin and subcutaneous fat down to the smooth cyst wall



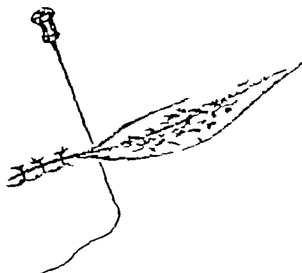
Dissection

4 Using the ellipse of skin as a tractor the cyst is enucleated by blunt and sharp dissection with a pair of scissors.



Haemostasis

5 Bleeding points are grasped with a haemostat. Twisting them is usually sufficient to control bleeding but occasionally diathermy or a ligature may be required



Avoidance of a bad scar

6 As the main indication for removing these cysts is cosmetic, care must be taken to ensure a good scar Should fine needles not be available a good result may be obtained using No 20 hypodermic needles. These are used to appose the skin edges Ophthalmic silkworm gut is then threaded a short distance into the bevel of the needle which is withdrawn and the thread tied.

POST-OPERATIVE

No dressing is required unless there is oozing from the skin edge when a light pressure dressing may be ap

[*The illustrations for this Chapter on Excision of Sebaceous Cyst were drawn by Mr F Price*]

Bibliography

Broders, A C., and Wilson, E. (1930) *Surg Clin. N Amer.*, 10 197
Caylor H. D (1925) *Ann Surg.*, 82, 164
Christopher F (1948) *Minor Surgery* Philadelphia Saunders.

EXCISION OF SUBCUTANEOUS DERMOID CYST

K. OWEN M.B., B.S., F.R.C.S

Assistant Director Surgical Unit St Mary's Hospital, London

PRE-OPERATIVE

rmoid cysts

)ermoid cysts arise as inclusion cysts from sequestrated dermal cells along the lines of embryonic fusion. They lined with squamous epithelium and usually contain caseous material In the head they commonly occur in the iporal region, at the glabella, in the median frontal region over the occiput and at the inner or outer canthus of eye. They may communicate with the meninges and the cyst may be of hour-glass shape with a narrow neck sing through the skull they rarely cause symptoms but occasionally may become infected. Dermoid cysts differ m sebaceous cysts in having no overlying punctum and being unattached to the skin, which can be moved ly over them they are usually firmly attached to the underlying periosteum and have very little mobility netimes expanding to a large size. Removal is usually for cosmetic reasons. Unless the cyst is very large it is sable to postpone operation until puberty or later as the chance of the cyst having an intracranial communi-ion is then less. Although the excision of a dermoid cyst is a relatively minor operation, this should be performed der full theatre aseptic conditions because of the possibility of an intracranial extension. It is necessary to remove cyst wall completely to ensure that it does not recur If it should be thought that a small piece of cyst wall has en left behind at the fascial attachment it may be destroyed with the diathermy button

plantation or epidermoid cysts

An implantation or epidermoid cyst is a similar subcutaneous epithelium-lined cyst but arises by implantation of idermis due to trauma, usually a puncture wound. They are most common on the hands or fingers but may arise any part of the body

reparation

The skin is shaved, part of the eyebrow being removed if necessary and prepared with iodine or spirit unless close the eye, when one of the quaternary ammonium compounds may be used.

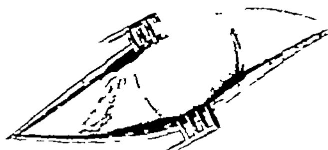
naesthesia

Although local anaesthesia may be used, general anaesthesia is preferable.



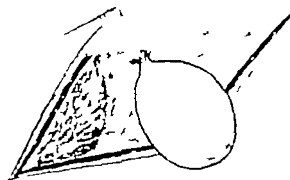
Incision

1 A suitably-placed linear incision is made this being in the line of the natural skin creases It may run along the eyebrow where the resulting scar will be concealed



Exposure of cyst

2 The incision is deepened through the orbicularis oculi fibres to expose the smooth wall of the cyst. Bleeding points are coagulated by diathermy

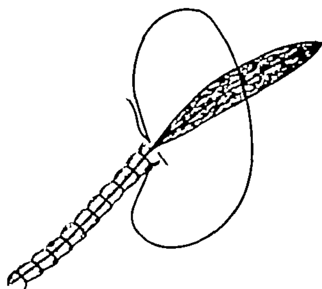


Removal of cyst

3 The cyst is dissected free and is usually found to be attached to the skull by a fibrous stalk which is divided. The cyst may be attached over a broad area. Its attachment is divided with a scalpel keeping close against the skull, so as to minimize the chance of leaving part of the cyst wall and hence inviting recurrence.

Wound closure

The scalp is sutured in two layers using interrupted sutures of fine silk.



POST-OPERATIVE

In most cases no dressing is necessary if the wound is dry but, should there be any oozing of blood, a pressure ·essing is applied. Sutures may be removed after 8 days.

Should a haematoma occur it should be aspirated. A slight effusion following excision of a dermoid cyst at the ter canthus may be accompanied by considerable oedema of the eyelids. This disappears rapidly and needs no eatment.

The possibility of recurrence has been discussed. Should a recurrent cyst appear it is excised, particular care being ken to remove the cyst intact if this is possible If this is not possible every fragment of epithelium must be re-ıoved or destroyed.

[*The illustrations for this Chapter on Excision of Subcutaneous Dermoid Cyst were drawn by Mr F Price*]

Bibliography

King, E. S. J (1933). *Brit. J Surg.*, **21**, 29
New G B., and Erich, J B (1937) *Surg Gynec Obstet.*, **65**, 48.
Ochsner A., and De Bakey M. E. (1935). *Christopher's Minor Surgery* Philadelphia, Saunders.

EXCISION OF PINNA

K Owen, M B , B.S., F R C.S

Assistant Director Surgical Unit St Mary's Hospital London

PRE-OPERATIVE

Indications

The condition for which this operation is most frequently required is carcinoma of the pinna which squamous or basal celled. These lesions usually ulcerate early Radiotherapy has been used in the treatment c lesions but is unsatisfactory in most cases because of the risk of cartilage necrosis and excision of the pinna sionally necessary in the treatment of such post-radiation necrosis Sarcoma is much more uncommon and p as a rounded tumour more frequently of the posterior surface than the anterior surface. It enlarges progr but is late to ulcerate Lympho-angio-endothelioma is extremely rare and of a lower degree of ma' either carcinoma or sarcoma. It has an irregular papilliferous surface and tends to ulcerate All these o particularly carcinoma, may present in various atypical ways and it is advisable to confirm the histology tumour by a small biopsy before proceeding to excision

Should there be involvement of the cervical lymph nodes, the excision of the pinna may be combined block dissection of the cervical lymph nodes The lymphatics of the posterior surface of the pinna drain into at the tip of the mastoid process The tragus and upper anterior lymphatics drain into the pre-auricular nod other nodes on the parotid gland. Metastases in this region may be superficial to the salivary gland or substance. The upper deep cervical nodes and the submandibular nodes may be involved in lymphatic dis of the disease

Preparation

Should there be any secondary infection of the tumour this is treated with a preliminary course of strepto or other suitable antibiotic. The skin is prepared with spirit. The internal meatus is cleaned well with a antiseptic and spirit and a small pledget of wool or piece of a dental roll soaked in spirit is placed in the beginning of the operation to prevent the accumulation of blood.

Anaesthesia

A general anaesthetic is used

Position of patient

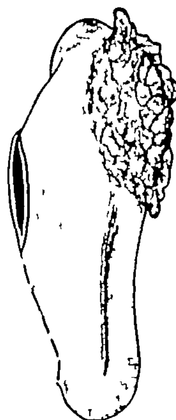
The patient lies supine with the opposite ear resting on a sandbag or mastoid pillow A slight degree of Trendelenburg tilt is used to lower venous pressure and reduce bleeding A double towel is placed under th the upper of the two towels being wrapped around the scalp above the ear

THE OPERATION



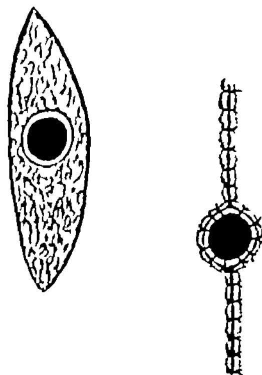
The incision

The incision follows the line of attachment of the pinna to the skull, provided of course that this leaves an adequate margin of healthy skin around the tumour In most cases the tragus may be spared and this simplifies the making of a prosthesis. If a block dissection is to be performed the lower end of this incision may be continued into the classical oblique incision for this operation



Excision of pinna

The pinna is severed, the cartilage of the external meatus being divided flush with the skull, using a scalpel. Should there be secondary involvement of the parotid nodes or parotid salivary gland these structures are removed with the pinna. The facial nerve is obviously at risk in these extended operations and may need to be sacrificed deliberately



Skin suture

3 The margins of the incision are then sutured together except at the external meatus where they are sutured to the cartilaginous margin

POST-OPERATIVE

A light gauze dressing is applied. This is not essential but spares the patient the embarrassment of re... ward with an obvious deformity Sutures are removed after 1 week A plastic reconstruction of the ear attempted as excellent prostheses may be obtained. These are held in position with a special adhesive cem may be fitted as soon as the wound has healed

One firm which makes this type of prosthesis is Messrs. Clement Clarke An impression can be taken as s the wound is healed and it is therefore possible to fit most patients with an artificial ear within a few w operation. The wearing of spectacles is no bar to this type of prosthesis

The patient should attend the follow-up clinic at monthly intervals for the first 3 months and then at 2-m or 3-monthly intervals At each attendance the neck and parotid regions are examined carefully for the pre enlarged lymph nodes. If lymph-node metastasis should occur it is treated by block dissection of the cervical Should glands near the sternomastoid insertion be involved it may be advisable to remove the tip of the process with the muscle.

[*The illustrations for this Chapter on Excision of Pinna were drawn by Mr F Price*]

Bibliography

Broders, A. C. (1921). *Surg Clin N Amer.*, 1, 1401
Eggston, A. A., and Wolff, A. B (1947) *Histopathology of the Ear Nose and Throat* Baltimore Williams and Wilkins.
Robinson, D W., Hardin, C. A., and Newby B G (1952) *Amer Surg.*, 18, 211
Robinson, G A. (1931). *Laryngoscope* 41, 467
Watkyn-Thomas, F W (1953) *Diseases of the Throat Nose and Ear* London Lewis.

XCISION OF OSTEOMA OF VAULT OF THE SKULL

K. Owen M.B., B.S., F.R.C.S
Assistant Director Surgical Unit St Mary s Hospital London

PRE-OPERATIVE

omas may arise from the inner or outer table of any part of the vault of the skull being most common on ital bone and the upper part of the parietal bone. Both internal and external osteomas tend to enlarge pro-ly and may be associated with headaches. Although benign, they tend to recur locally if removed in-tely so that excision of these tumours should include a small margin of healthy bone. Osteomas of the nasal may enlarge upwards into the anterior fossa, with the danger of cerebrospinal rhinorrhoea and meningitis. ay become sequestrated and lie unattached within the sinus. A tumour may occasionally arise within the erode into the orbit, giving rise to proptosis and pressure on the globe with impairment of vision. Osteo-the calvarium rarely produce localizing cerebral symptoms but they may occasionally enlarge sufficiently uce cerebral compression and epilepsy has been reported (Pilcher 1938) The excision of osteomas may be d for any of these reasons or simply in the case of external table tumours, on cosmetic grounds.

tumours have an outer layer of hard cortical bone and an inner layer of cancellous bone. The proportion of vo types of bone varies considerably but in general the small, slowly growing tumours are found to consist of dense, hard, mature cortical bone, while the more rapidly growing larger tumours have a prepon-of cancellous bone with areas of cellular vascular connective tissue separating bone spicules. The pathology tumours has been well described by Geschichter (1936) A history of trauma is given by less than half the and is probably insignificant in many of these. Cases have been described of an osteoma being present at

excision of small osteomas is usually without danger but as inner table tumours expand they often erode h the dura so that the neck of the growth is encircled by dura. If a bone flap containing such a tumour is d blindly there is considerable danger of dural laceration with tearing of dural vessels and possibly venous , so that severe haemorrhage may occur In large tumours where this risk seems great, hypotensive anaesthesia considered but the dangers of this method tend to outweigh the advantages if used unnecessarily In most ppreciation of the danger and planning of the operation so as to approach the neck of the tumour under vision, will obviate the need for hypotensive measures other than posture.

aration

skin is shaved and prepared with iodine or spirit as for other cranial operations. Although in most cases only l scalp shaving is necessary this should be adequate to allow the making of a flap if the need arises. In order to haemorrhage, the operation may be performed with the patient in the sitting position or in a reverse delenburg position, this being maintained with a foot rest and a broad strap over the knees.

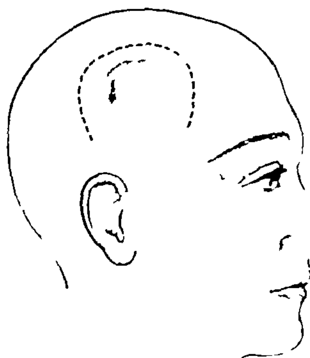
sthesia

l or general anaesthesia may be used. General anaesthesia is preferable as the drilling and cutting of bone is sant to most patients although only rarely painful 1 per cent lignocaine with adrenaline 1 100 000 is a e local anaesthetic.

THE OPERATION

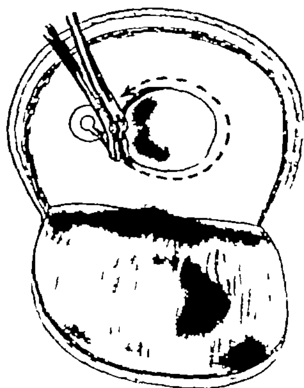
The incision

1 A linear incision may be used for a small osteoma but for a larger tumour a scalp flap should be turned down



External osteomas

2 A burr-hole is made near one border of the tumour which is then excised with a small margin of healthy bone, using forceps of the de Vilbiss type. It may be possible in some early cases to remove the tumour completely with a margin of external table only As the tumours enlarge, however they tend to obliterate the diploe, making a full thickness skull removal essential for complete removal of the tumour It is inadvisable to attempt to remove the tumour by chiselling it off the external table as this may be extremely difficult in the case of an ivory osteoma. The removal may be incomplete and result in recurrence of the tumour Scalp haemostasis is secured by digital pressure on each side of the incision until Raney's clips or mosquito forceps can be applied to the scalp Any large individual bleeding points are coagulated with diathermy Bleeding from the scalp is controlled by the use of bone wax



XCISION OF OSTEOMA OF VAULT OF THE SKULL

K. Owen M.B., B.S., F.R.C.S

Assistant Director Surgical Unit St Mary's Hospital London

PRE-OPERATIVE

steomas may arise from the inner or outer table of any part of the vault of the skull, being most common on frontal bone and the upper part of the parietal bone. Both internal and external osteomas tend to enlarge prossively and may be associated with headaches. Although benign, they tend to recur locally if removed inquately so that excision of these tumours should include a small margin of healthy bone Osteomas of the nasal uses may enlarge upwards into the anterior fossa, with the danger of cerebrospinal rhinorrhoea and meningitis. ey may become sequestrated and lie unattached within the sinus. A tumour may occasionally arise within the nt or erode into the orbit, giving rise to proptosis and pressure on the globe with impairment of vision. Osteos of the calvarium rarely produce localizing cerebral symptoms but they may occasionally enlarge sufficiently produce cerebral compression and epilepsy has been reported (Pilcher 1938) The excision of osteomas may be licated for any of these reasons or simply in the case of external table tumours, on cosmetic grounds

The tumours have an outer layer of hard cortical bone and an inner layer of cancellous bone. The proportion of se two types of bone varies considerably but in general the small slowly growing tumours are found to consist inly of dense, hard, mature cortical bone while the more rapidly growing, larger tumours have a preponrance of cancellous bone with areas of cellular vascular connective tissue separating bone spicules. The pathology these tumours has been well described by Geschichter (1936) A history of trauma is given by less than half the tients and is probably insignificant in many of these. Cases have been described of an osteoma being present at rth.

The excision of small osteomas is usually without danger but as inner table tumours expand they often erode rough the dura so that the neck of the growth is encircled by dura. If a bone flap containing such a tumour is vated blindly there is considerable danger of dural laceration with tearing of dural vessels and possibly venous uses, so that severe haemorrhage may occur In large tumours where this risk seems great, hypotensive anaesthesia ay be considered but the dangers of this method tend to outweigh the advantages if used unnecessarily In most ses appreciation of the danger and planning of the operation so as to approach the neck of the tumour under rect vision, will obviate the need for hypotensive measures other than posture.

reparation

The skin is shaved and prepared with iodine or spirit as for other cranial operations. Although in most cases only mited scalp shaving is necessary this should be adequate to allow the making of a flap if the need arises. In order to duce haemorrhage, the operation may be performed with the patient in the sitting position or in a reverse rendelenburg position, this being maintained with a foot rest and a broad strap over the knees.

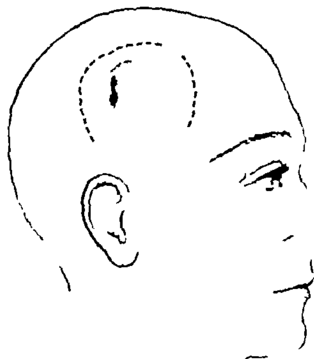
naesthesia

Local or general anaesthesia may be used. General anaesthesia is preferable as the drilling and cutting of bone is mpleasant to most patients, although only rarely painful 1 per cent lignocaine with adrenaline 1 100 000 is a uitable local anaesthetic.

THE OPERATION

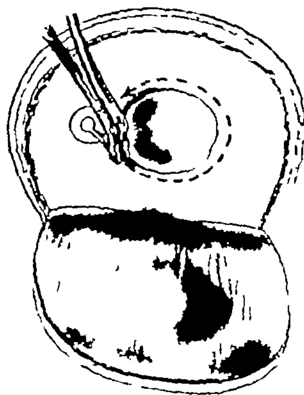
The Incision

1 A linear incision may be used for a small osteoma, but for a larger tumour a scalp flap should be turned down



External osteomas

2 A burr-hole is made near one border of the tumour which is then excised with a small margin of healthy bone, using forceps of the de Vilbiss type It may be possible in some early cases to remove the tumour completely with a margin of external table only As the tumours enlarge however they tend to obliterate the diploe making a full thickness skull removal essential for complete removal of the tumour It is inadvisable to attempt to remove the tumour by chiselling it off the external table as this may be extremely difficult in the case of an ivory osteoma. The removal may be incomplete and result in recurrence of the tumour Scalp haemostasis is secured by digital pressure on each side of the incision until Raney's clips or mosquito forceps can be applied to the scalp Any large individual bleeding points are coagulated with diathermy Bleeding from the scalp is controlled by the use of bone wax.



XCISION OF OSTEOMA OF VAULT OF THE SKULL

K. OWEN M.B., B.S., F.R.C.S

Assistant Director Surgical Unit St Mary's Hospital London

PRE-OPERATIVE

steomas may arise from the inner or outer table of any part of the vault of the skull, being most common on frontal bone and the upper part of the parietal bone. Both internal and external osteomas tend to enlarge pro-ssively and may be associated with headaches. Although benign, they tend to recur locally if removed in-quately so that excision of these tumours should include a small margin of healthy bone. Osteomas of the nasal uses may enlarge upwards into the anterior fossa, with the danger of cerebrospinal rhinorrhoea and meningitis. ey may become sequestrated and lie unattached within the sinus. A tumour may occasionally arise within the nt or erode into the orbit, giving rise to proptosis and pressure on the globe with impairment of vision. Osteo-s of the calvarium rarely produce localizing cerebral symptoms but they may occasionally enlarge sufficiently produce cerebral compression and epilepsy has been reported (Pilcher 1938) The excision of osteomas may be licated for any of these reasons or simply in the case of external table tumours, on cosmetic grounds.

he tumours have an outer layer of hard cortical bone and an inner layer of cancellous bone. The proportion of se two types of bone varies considerably but in general the small, slowly growing tumours are found to consist unly of dense hard, mature cortical bone while the more rapidly growing larger tumours have a prepon-rance of cancellous bone with areas of cellular vascular connective tissue separating bone spicules. The pathology these tumours has been well described by Geschichter (1930) A history of trauma is given by less than half the tients and is probably insignificant in many of these. Cases have been described of an osteoma being present at rth.

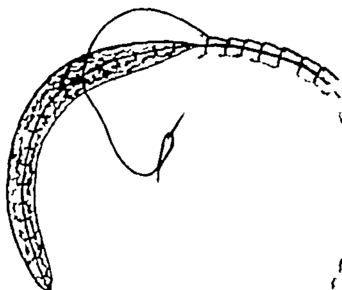
The excision of small osteomas is usually without danger but as inner table tumours expand they often erode rough the dura so that the neck of the growth is encircled by dura. If a bone flap containing such a tumour is -vated blindly there is considerable danger of dural laceration with tearing of dural vessels and possibly venous nuses so that severe haemorrhage may occur In large tumours where this risk seems great, hypotensive anaesthesia ay be considered but the dangers of this method tend to outweigh the advantages if used unnecessarily In most ses appreciation of the danger and planning of the operation so as to approach the neck of the tumour under rect vision, will obviate the need for hypotensive measures other than posture.

reparation

The skin is shaved and prepared with iodine or spirit as for other cranial operations. Although in most cases only mited scalp shaving is necessary this should be adequate to allow the making of a flap if the need arises. In order to duce haemorrhage, the operation may be performed with the patient in the sitting position or in a reverse rendelenburg position, this being maintained with a foot rest and a broad strap over the knees.

aesthesia

Local or general anaesthesia may be used. General anaesthesia is preferable as the drilling and cutting of bone is npleasant to most patients, although only rarely painful 1 per cent lignocaine with adrenaline 1 100 000 is a itable local anaesthetic.



Wound closure

5 The scalp is then sutured in two layers, using fine interrupted silk sutures for the aponeurosis and a continuous blanket stitch for the skin

POST-OPERATIVE

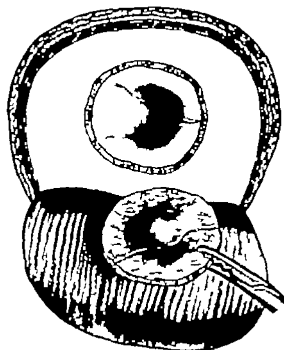
A pressure dressing is applied to the wound and left in position for 8 days, the sutures being removed at the this time.

Should a haematoma occur it is aspirated and a pressure dressing reapplied

[*The illustrations for this Chapter on Excision of Osteoma of Vault of the Skull were drawn by Mr F Price*]

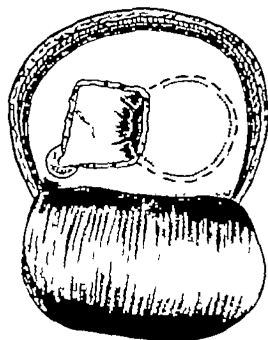
Bibliography

Echlin F (1934). *Arch Surg.*, **28**, 357
Geschickter C. F (1936) *Amer J Cancer* **26** 155
Pilcher C. (1938) *Sth med J.*, **31**, 618
— (1940). *Surgical Treatment of the Nervous System* Philadelphia Lippincott.



Small internal osteomas

A small internal osteoma may be removed in the same way nibbling around the tumour from an adjacent burr-hole. Bleeding from the bone edge may be controlled with Horsley's wax. Bleeding dural vessels are coagulated with diathermy or under-run with a fine silk *stitch*.



Large internal osteomas

Because of the danger of haemorrhage in cases where the osteoma has eroded through the dura the neck of the tumour should be approached under direct vision It is therefore exposed by nibbling a window at one side of the tumour or by raising a formal bone flap (the choice depending upon the size and situation of the tumour) The osteoma is then removed with a rim of normal bone, any dural division necessary being performed *under direct vision*. In the case of a very large tumour it may be removed as the centre of a formal bone flap using burr-holes connected by a Gigli saw



Wound closure

5 The scalp is then sutured in two layers using fine interrupted silk sutures for the aponeurosis and a continuous blanket stitch for the skin

POST-OPERATIVE

A pressure dressing is applied to the wound and left in position for 3 days, the sutures being removed at the this time.

Should a haematoma occur it is aspirated and a pressure dressing reapplied.

[The illustrations for this Chapter on Excision of Osteoma of Vault of the Skull were drawn by Mr F.Price]

Bibliography

Echlin, F (1934). *Arch. Surg.*, **28**, 357
Geschickter C. F (1936) *Amer J Cancer* **26** 155
Pilcher C. (1938). *Sth med J.*, **31**, 618
— (1946) *Surgical Treatment of the Nervous System* Philadelphia Lippincott.

SURGICAL TREATMENT OF TUBERCULOUS CERVICAL LYMPH NODES

M. R. Ewing, M.B., Ch.B., F.R.C.S
Professor of Surgery University of Melbourne

PRE-OPERATIVE

general, tuberculous cervical lymphadenitis is best treated medically Excision is indicated only when the is confined to a single group of nodes and when the patient is otherwise well. Although caseation is no bar cold abscess formation may make dissection exceedingly difficult. Surgery is also valuable in dealing nodes which have failed to subside completely under medical treatment.

st surgeons believe that dissection is the most desirable procedure, even when there is a cold abscess present, some advocate a more conservative approach in these cases, recommending evacuation of the contents by or by minimal incision followed by curettage or expression.

e aim of operation is, by removing pus and caseating material from lymph nodes which are breaking down, to the natural process of healing By anticipating the breakdown of the overlying skin, it may lessen the risk disfiguring scar As a method of treatment it is complementary to general measures and to a course of anti- and chemotherapy

tra-indications

hen there is clinical evidence of a mixed pyogenic and tuberculous infection it is wise to defer operation until completion of an intensive (24–48 hours) course of penicillin or some other suitable antibiotic.

pre-operative treatment

cal treatment should be given to any focus of associated pyogenic infection and the antibiotics of choice d be administered.

eneral anaesthesia with an endotracheal tube is the one of choice.

tion of patient

he shoulders should be supported by a low pillow and the occiput can conveniently be steadied by a ring-shaped To lessen venous bleeding the table is tilted a little, feet down.

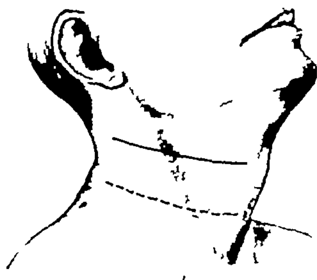
double head towel is applied and the others are so arranged as to give access to the whole side of the neck. This it easy to recognize the landmarks and to control bleeding in the event of injury to a major vessel

THE OPERATIONS

DISSECTION

The incision

1 The length and position of the incision will depend on the situation of the lymph node group affected. It should however always be made along the line of a skin crease. There is great merit in making long incisions. The extent of the disease often turns out to be greater than is suspected clinically and free exposure is essential where there is any risk of injury to main vessels.



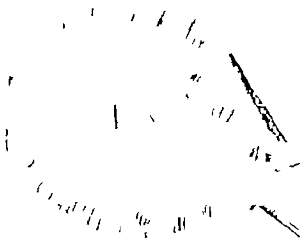
Skin flaps

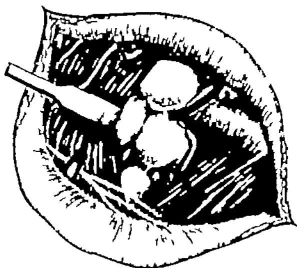
2 Platysma is included in the skin flaps which are turned back widely. The external jugular vein and cutaneous branches of the cervical plexus will be found on the sterno-mastoid muscle.



Division of cervical fascia

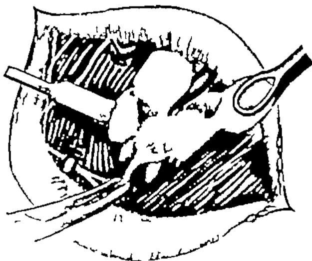
3 To gain access to the plane of the lymph nodes, the fascia is divided along the anterior margin of the sterno-mastoid.





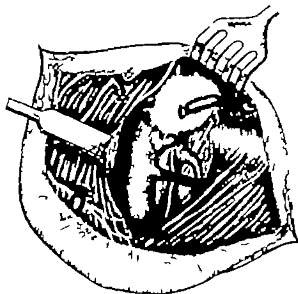
Retraction of sterno-mastoid

The external jugular vein is secured (it often helps to resect a short segment) When the sterno-mastoid muscle is retracted, the enlarged nodes will be found closely applied to the internal jugular vein



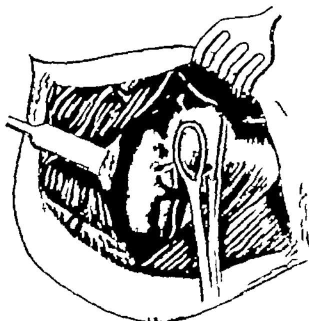
Beginning of the lymph node dissection

The lowest accessible node is seized with gland forceps and is turned upwards. The nodes are most easily separated from the vessels by blunt dissection with tonsil scissors.



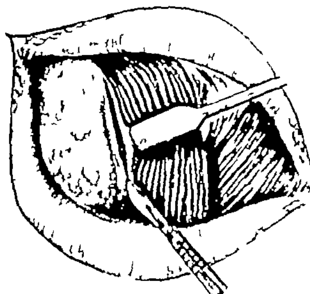
Division of common facial vein

It is usually necessary to sacrifice several of the tributaries of the internal jugular vein The ansahypoglossi can with care be preserved The accessory nerve runs a short course in the anterior triangle It can be recognized where it enters the anterior margin of the sterno-mastoid muscle close to its insertion



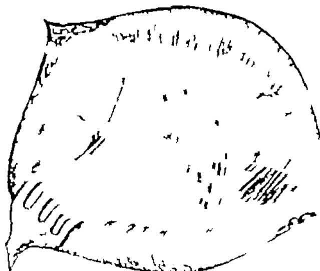
Hypoglossal and spinal accessory nerves

7 A branch of the occipital artery is often a guide to the accessory nerve The hypoglossal nerve can be seen only by retracting the lower margin of the posterior belly of the digastric.



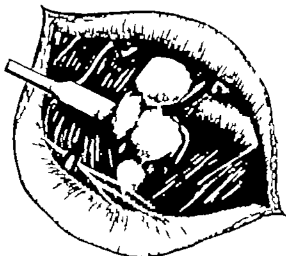
Access to the posterior triangle

8 The fascia is now divided along the posterior margin of the sterno-mastoid.



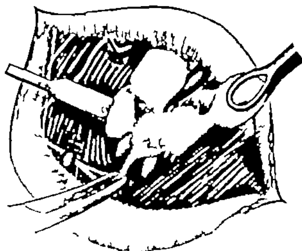
Dissection of nodes along accessory nerve

9 When the muscle is retracted forwards access is available to the nodes which lie in relation to the posterior border of the vein and disposed along the nerves which cross the posterior triangle They are commonly closely applied to the accessory nerve which is very superficial and correspondingly vulnerable



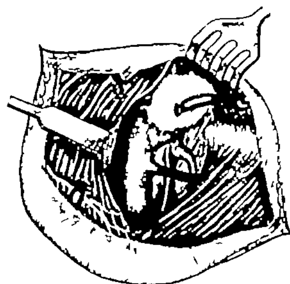
Retraction of sterno-mastoid

4 The external jugular vein is secured (it often helps to resect a short segment) When the sterno-mastoid muscle is retracted, the enlarged nodes will be found closely applied to the internal jugular vein



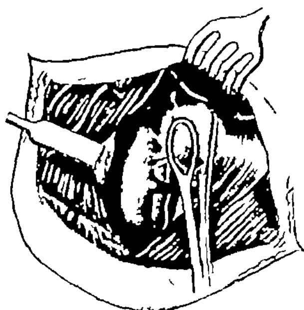
Beginning of the lymph node dissection

5 The lowest accessible node is seized with gland forceps and is turned upwards The nodes are most easily separated from the vessels by blunt dissection with tonsil scissors



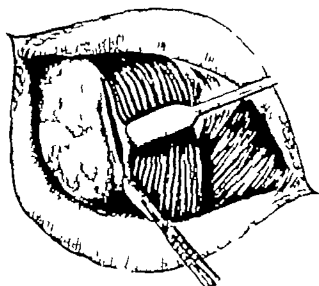
Division of common facial vein

6 It is usually necessary to sacrifice several of the tributaries of the internal jugular vein. The ansahypoglossi can with care be preserved. The accessory nerve runs a short course in the anterior triangle It can be recognized where it enters the anterior margin of the sterno-mastoid muscle close to its insertion.



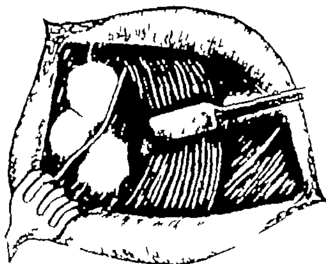
Hypoglossal and spinal accessory nerves

7 A branch of the occipital artery is often a guide to the accessory nerve. The hypoglossal nerve can be seen only by retracting the lower margin of the posterior belly of the digastric.



Access to the posterior triangle

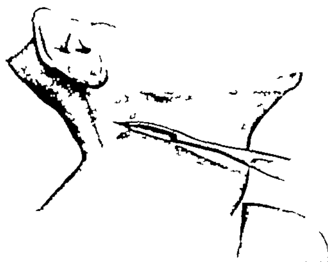
8 The fascia is now divided along the posterior margin of the sterno-mastoid.



Dissection of nodes along accessory nerve

9 When the muscle is retracted forwards, access is available to the nodes which lie in relation to the posterior border of the vein and disposed along the nerves which cross the posterior triangle. They are commonly closely applied to the accessory nerve which is very superficial and correspondingly vulnerable

EVACUATION OF COLD ABSCESS



The incision

10 An incision is made with a tenotomy knife over the summit of the abscess which may be immediately under an attenuated layer of skin or still more deeply under the fascia. The incision will be no more than 0 5 cm. long and in line with one of the skin creases.

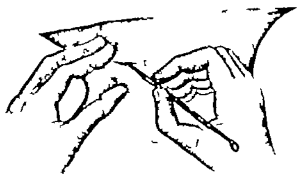


Evacuation of abscess

11 The content of any subcutaneous abscess is evacuated. The depths of the cavity are now explored by a small (3–4 mm) spoon or curette One or more sinuses will be discovered leading deeper into the subfascial planes of the neck and into the disintegrating lymph nodes When there is no subcutaneous abscess the deep fascia will have to be divided to give access to the plane of the nodes.

Method of curettage

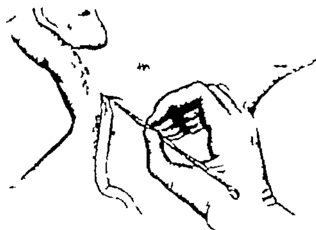
12 The curette must be directed into every accessible lymph node in turn Each is steadied between the finger and thumb as the curette is cautiously advanced towards its centre. So soon as the caseous material is discovered, the instrument can be used vigorously without danger to vessels or to nerves



Alternative expression of tuberculous lymph nodes

Some surgeons are reluctant to practise blind curettage in the neck for fear of causing injury or alternatively because of the risk of spreading the infection

They prefer to evacuate the disintegrating nodes by expelling the necrotic content by firm sustained pressure with the finger from either a short tenotomy incision or into the cavity of an emptied subcutaneous cold abscess.



Haemostasis

13 Haemostasis is secured by packing for a few minutes with ribbon gauze



Closure

14 The wound is closed with one or two interrupted sutures and gentle pressure applied over a generous dressing

SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Injury to the facial nerve

The cervical branch of the facial nerve is necessarily divided in most neck dissections. The resulting paralysis [of] the platysma muscle is seldom detectable clinically

Division of or injury to the mandibular (marginalis) branch is followed by a paralysis of the depressor of t[he] lower lip This is often permanent. Less of the vermilion border of the lip then shows on the injured side a[nd] asymmetry of the mouth becomes most obvious in the fully opened position

Haematoma formation

This is a common complication but can be obviated (1) by careful haemostasis (2) by drainage (3) by a pressu[re] dressing and (4) by the intelligent use of sinus forceps and an aspirating needle in the post-operative period.

[*The illustrations for this Chapter on Surgical Treatment of Tuberculous Cervical Lymph Nodes were drawn by M[r] Jill Payne*]

INCISION OF ACUTE CERVICAL ABSCESS

M R EWING, M.B CH.B F R C S

Professor of Surgery University of Melbourne

PRE-OPERATIVE

Indications

Drainage of an abscess of the neck is indicated in cases of lymphadenitis secondary to tonsillitis, facial furunculosis or impetigo also in instances of dental infection, and Ludwig s angina.

Incision should not be too long deferred for fluctuation is comparatively late. This is especially the case when antibiotics have been used for some days, and when there results a thick-walled cavity with only a very small amount of pus. It is important to remember the possibility of underlying infection in bone actinomycosis should also be borne in mind.

Special contra-indications

A necrotic cervical node metastasis may present as an acute abscess. Incision is followed by distressing fungation of the tumour through the wound.

Special equipment or apparatus

A good light is an essential and a sucker may be invaluable. An adequate supply of artery forceps is also advisable

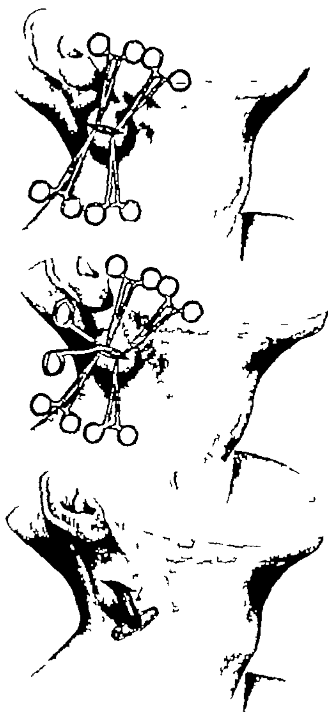
Anaesthesia

General anaesthesia and an assured airway should be insisted upon. Hurried incision under gas and oxygen anaesthesia too often results in the abscess being missed.

Position of the patient

The head should be resting firmly on a sandbag Towelling should be done carefully to give a generous exposure. It is an advantage to have a slight head-up tilt of the whole table as bleeding may be brisk.

THE OPERATION



Incision

1 Acute abscesses are met with most commonly in the submandibular region An incision is made through skin and platysma immediately over the summit of the inflammatory swelling and running along the line of a skin crease It should be at least 2 cm long so as to give enough room for the application of forceps to secure haemostasis.

"Seeking" the abscess

2 A pair of sinus forceps is now plunged boldly into the swelling Failure to find the abscess is often due to timidity The blades of the forceps are opened the little finger is then insinuated to widen the drainage track.

Drainage

3 A small strip of thin corrugated rubber drain (with a safety pin) does little more than hold the edges of the incision apart.

POST-OPERATIVE CARE

Secondary suture is seldom required If the incision has been carefully planned it will heal promptly to leave inconspicuous scar

[*The Illustrations for this Chapter on Incision of Acute Cervical Abscess were drawn by Miss J Payne*]

REMOVAL OF CYSTIC HYGROMA

B McN Truscott M.B.E., M.A., M.B., F.R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

The indications for operating on cystic hygromas are for pressure effects on surrounding structures, for cosmetic reasons and to avoid secondary infection

There are other methods of treatment which can be adopted and these must be considered before deciding on excision. These methods are conservative treatment to await spontaneous improvement, aspiration, the injection of sclerosants, and radiotherapy

Spontaneous improvement does occur in a small percentage of cases. A waiting policy can be adopted in a small tumour causing no severe symptoms. In an infant with a large tumour which is not causing symptoms it is well to wait until the child is 2 years old By this time the tissues are easier to deal with and dissection not so difficult.

Aspiration will relieve tension in a cyst which is causing sudden severe pressure effects but is useless as a final treatment as re-accumulation is certain and the risk of infection high.

Sclerosants have been successful in some cases but there may be a large free communication with the main lymphatic channels and the sclerosants may spread beyond a safe boundary

Radiotherapy may improve the lesion but the results are unpredictable and any further surgery which may be required made more difficult.

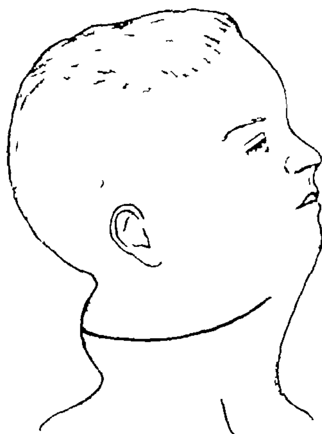
Excision is therefore the treatment of choice.

Anaesthesia

A general anaesthetic is required through an endotracheal tube passed through the mouth to allow a tube of sufficiently wide calibre to be used.

Position of patient

The position of the patient will depend to some extent on the site of the lesion. The majority will be reached satisfactorily with the patient in the supine position. If however the cyst reaches right down to the posterior part of the neck, the supraclavicular triangle or even the axillary region suitable adjustments will have to be made.



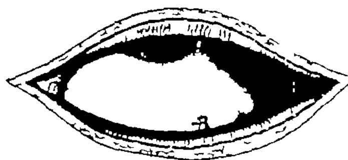
THE OPERATION

The incision

1 The incision will be influenced to some extent by the situation and size of the cyst Ordinarily a transverse incision in a skin crease is made centred over the middle of the tumour and extending far enough on each side of the cyst to allow wide exposure and easy mobilization.

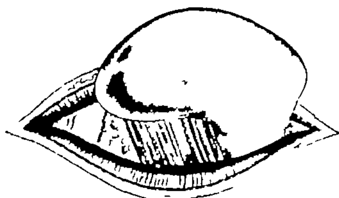
Skin flaps

2 Skin and subcutaneous fat will require wide undercutting to display the full extent of the cyst. Small loculi may be found quite superficially in the subcutaneous tissues. If the external jugular vein interferes with exposure it should be ligated and divided.



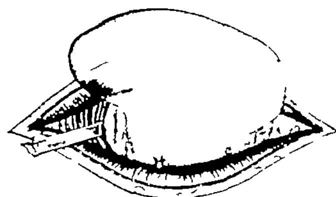
Mobilization of superficial portion of cyst

3 The plane of cleavage between the cyst wall and surrounding tissues should be identified and the superficial portion of the cyst separated from the surrounding tissues by blunt dissection. *Great care and gentleness will be* needed to avoid rupturing the thin wall of the cyst. No tissue forceps or instruments of any kind should be used to hold the cyst. When the blunt dissection is complete the cyst will be free except for its attachment to deeper structures.



Identification of major structures of the neck

4 Owing to the tendency of the cyst to send ramifications deep into the structures of the neck complete removal will require careful dissection in the muscle planes. To avoid damage to major structures such as the carotid arteries, the jugular vein and hypoglossal and accessory nerves, these structures, when in the field of dissection should be deliberately isolated before attempting removal of the cyst.



Removal of the cyst and closure of the wound

5 After the main structures have been displayed *each ramification of the cyst is dissected out* with care until the whole cyst is removed complete If however there are multiple small loculi complete removal of all these may be impossible and only the main cyst is taken.

The skin flaps are approximated with interrupted silk sutures. If the cyst has been a large one and there is a large amount of excess skin an ellipse of this skin should be excised The wound should always be drained.



POST-OPERATIVE CARE

Alternate sutures are removed on the fourth post-operative day and the remainder the day after The dr is shortened after 24 hours and removed on the second post-operative day

As it is probable that small loculi will have been cut across, collections of lymph in the space previou occupied by the cyst may well occur If this happens repeated aspiration will be necessary

An incomplete excision may have to be accepted in a case with many small loculi and ramifications. Spo taneous retrogression of the residual tumour may be expected.

[*The illustrations for this Chapter on Removal of Cystic Hygroma were drawn by Mr Frank Price*]

Bibliography

Gross, R. E., and Goeringer C. F (1939). "Cystic Hygroma of the Neck. Report of 27 Cases." *Surg Gynec Obstet* 69

REMOVAL OF SUB-MENTAL DERMOID CYST

B McN Truscott M.B.E., M.A., M.B., F.R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

The cyst presents as a swelling thrusting up under the tongue internally and in the sub-mental region externally Pressure upwards on the tongue and the appearance of the lump externally are the symptoms which require alleviation. Additional indications are infection or increase to a size which may embarrass respiration in infants, but the more usual picture is that of a slowly increasing lump noticed at the time of puberty

Pre-operative preparation

The standard pre-operative steps for all operations near the oral cavity will be required. Particular attention should be paid to dental hygiene.

Anaesthesia

Anaesthesia should be administered through an endotracheal tube which in children will be most conveniently inserted through the mouth

Position of patient

The patient should be in the supine position with the shoulders supported on a pillow and the neck extended to the maximum. The head, neck and thorax should be raised by tilting the table and the body maintained in this position on the table by a canvas sheath (*see also* Branchial Cyst and Cervical Sinus, Part VI page 84)

THE OPERATION

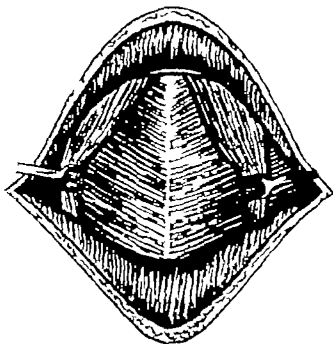
The incision

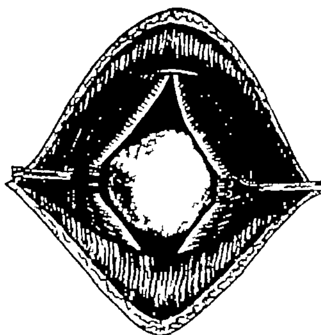
1 A curved transverse incision is made convex downwards with the centre situated over the middle of the tumour in the submental region These tumours are always more conveniently removed externally than through the mouth



Skin flaps and separation of anterior bellies of digastric muscles

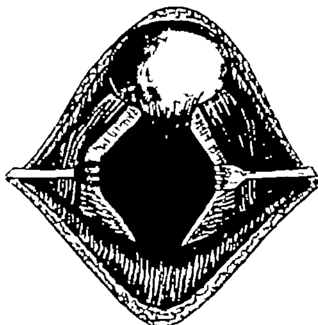
2 The skin, subcutaneous fat and platysma are reflected upwards as far as the under-surface of the mandible and downwards to the upper border of the hyoid bone, exposing the anterior bellies of the digastric muscles. The medial edge of each anterior belly of the digastric muscle is identified and separated. Each muscle belly is then retracted laterally exposing the underlying mylo-hyoid muscles.





Exposure of cyst

3 The median raphe between the mylo-hyoids is identified and incised, separating each muscle component from the base of the tongue above to the hyoid bone below This exposes the cyst wall lying deep to the muscles. The separated muscle bellies are retracted medially

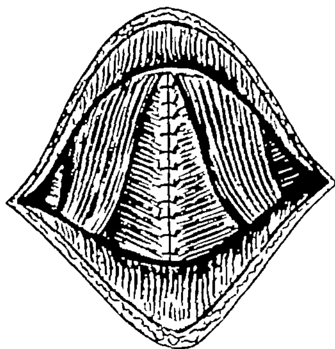


Removal of cyst

4 The cyst is separated from the underlying genio-hyoid muscles by blunt dissection in the plane of cleavage until all but the deep surface of the cyst is free It is then turned upwards and the dissection continued into the base of the tongue When the cyst is free on all surfaces it is removed.

Closure

5 The mylo-hyoid muscles are sutured together with interrupted catgut sutures. The skin subcutaneous tissue and platysma are approximated with silk sutures or clips. Drainage is not required



POST-OPERATIVE CARE AND COMPLICATIONS

Removal of sutures or clips

As in all operations on the neck above the level of the thyroid cartilage skin sutures or clips should not be remov until the fourth and fifth days. Earlier removal, which is satisfactory lower down the neck, is inadvisable owing tension on the flaps if the neck is extended.

Reactionary haemorrhage

Should even a relatively small quantity of bleeding occur in the wound it may cause respiratory embarrassme by upward pressure on the tongue It should be relieved by immediate removal of the skin sutures and opening of the interval between the hyo-glossus muscles The bleeding point can later be secured under general anaesthesi.

[The illustrations for this Chapter on Removal of Sub-mental Dermoid Cyst were drawn by Mr F Price]

Bibliography

Hoover W B (1933). *Surg Clin N Amer* June, p 645
Korchin, L. (1951). *Med. J U.S.A.F.*, **2**, 299

BRANCHIAL CYST AND CERVICAL SINUS

B McN Truscott M.B.E., M.A., M.B., F.R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

Branchial cysts require removal because they persist and increase in size they do not undergo spontaneous retrogression A cervical sinus exudes a small quantity of discharge, to the annoyance of the patient.

In addition, the likelihood of secondary infection in the sinus is high and the chance of spontaneous closure small. Branchial cysts may also become infected, and once infection has occurred dissecting out a cyst or a sinus is made much more difficult and tedious. A pleasant neat operation can be converted into a tiresome unsatisfactory affair in such cases.

While a branchial cyst is not usually recognized before the age of 5 years, and more commonly not before early adult life, a cervical sinus is recognized in early infancy Removal can be delayed until the age of 15 months, but owing to the incidence of infection the operation should not be ordinarily postponed after that time.

Anaesthesia

General anaesthesia through an endotracheal tube should be the standard method adopted particular attention being paid to the avoidance of any obstruction to free respiration. Free expiration is as important as unobstructed inspiration and the anaesthetist should be persuaded to avoid too narrow a tube too much pressure on any escape valve or too cumbersome and heavy a rebreathing bag Any obstruction will cause an engorgement of the neck veins with consequent increase in bleeding In children, therefore, the endotracheal tube will require to be inserted *through the mouth as it is difficult to get one of sufficient width through the nose.*

Position of patient

The head and trunk should be raised by tilting the table so that they are at an angle of 30 degrees from the horizontal plane. By gravity the veins of the neck are emptied and bleeding lessened. The most satisfactory method of holding the patient in this position is by means of a canvas sheath A rigid foot plate fixed to the end of the table is perhaps simpler but the canvas sheath is readily adaptable to all types of table and all sizes of patient apart from small infants

The patient is in the supine position and the neck is extended by placing a pillow under the shoulders, with a second pillow under the head. The point of the chin is turned away from the affected side

Towelling

Towels are placed along each side of the neck and another across the chest just below the manubrium sterni forming the third side of a square The fourth towel is held to the first two by clips just below the mastoid process, and is then thrown back over the chin and head

THE OPERATIONS

BRANCHIAL CYST OPERATION

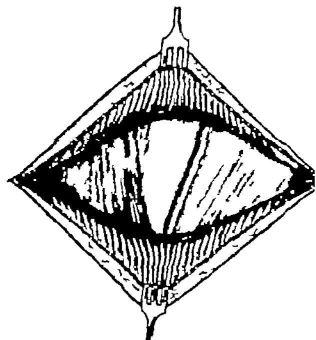
Incision

1 The incision is transverse with a slight downwards convexity in a natural crease of the skin it is centred over the cyst The length will depend on the size of the cyst, but it should be long enough to allow sufficient upward and downward dissection of the skin flaps to give free exposure of the cyst.



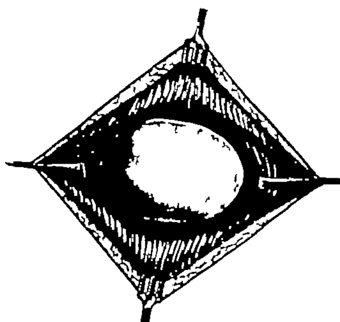
Skin flaps

2 The incision is carried through skin, subcutaneous fat and platysma down to the deep cervical fascia. The flaps are reflected upwards and downwards until a satisfactory exposure of the cyst has been obtained.



Exposure of the cyst

3 The investing layer of deep cervical fascia attached to the anterior border of the sterno-mastoid muscle is incised. This muscle is separated from the fascia throughout the length of the incision and retracted laterally. The superficial aspect of the cyst is exposed by incising the overlying fascia and retracting the sterno-hyoid muscle medially.

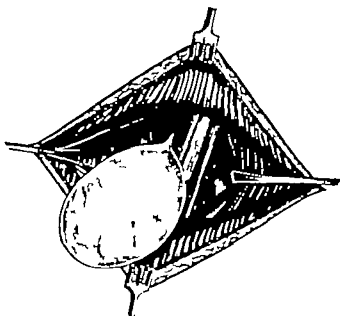


Isolation and removal of the cyst

4 No attempt should be made to grasp the cyst wall with instruments or it will rupture. Rather the structures around it should be swept away by gentle blunt dissection until the cyst lies free, except on its deep surface. The immediate deep relation of the cyst may be the internal jugular vein. When completing the final dissection care must be taken to avoid injury to this structure.

The secret of this blunt dissection is to get into the correct plane close to the cyst wall before starting any stripping.

When freed from all surrounding structures the cyst can be lifted from the wound. It may still be tethered deeply by a pedicle. If such a pedicle is found it should be dissected down to this region and ligated.





Wound closure

5 The incision in the pre-tracheal fascia is closed with interrupted fine catgut sutures. The platysma is closed with a running fine catgut suture. The skin is closed without drainage with clips or silk sutures.

CERVICAL SINUS OPERATION

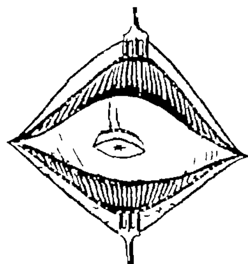


Position and incision

6 The position of the patient is as for a branchial cyst operation but adjustments may have to be made when, as is usual, the subject is an infant or small child.

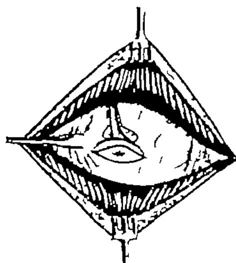
The incision is transverse in a natural skin crease, centred on the sinus and extending on either side. An ellipse of skin is left surrounding the sinus. It must be remembered that upward dissection for a considerable distance will have to be made and the incision must be long enough to allow this.

Complete excision of the tract sometimes requires a second incision parallel to the first and at a higher level.



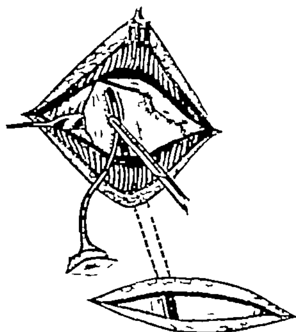
Skin flaps

7 Platysma, fat and skin are reflected upwards to the level of the lower border of the thyroid cartilage in the first instance. The lower flap is dissected downwards for a short distance leaving the sinus with its surrounding ellipse of skin projecting above the deep cervical fascia.



Dissection of the sinus tract

8 The anterior border of the sterno-mastoid muscle is separated from the deep cervical fascia and retracted laterally. This fascia is incised longitudinally exposing the sinus lying underneath it. A little traction on the sinus will make it stand out and render identification and dissection easier. The tract is dissected out and followed upwards until it reaches the upper limits that can be comfortably approached through the incision.



Extension of the incision

9 The tract may run higher in the neck than can be reached easily through the original incision, in which case further incision should be made higher up—the so-called "staircase" incision. This incision is placed so that it lies over the highest point reached from below. Skin, fat and platysma are reflected upwards and downwards, the anterior border of the sterno-mastoid muscle is freed and retracted as before and the sinus identified. The whole of the sinus and the ellipse of skin are pulled through from the lower incision and the upward dissection continued.

The sinus must be dissected up to its origin from the wall of the pharynx. Its relation to the carotid vessels will vary according to which branchial arch it originated from, but commonly it passes between the internal and external carotid arteries. When the point of origin is reached the sinus is clamped, ligated and removed.

Closure of the wound

Closure of the wound is the same as for branchial cyst.

[The illustrations for this Chapter on Branchial Cyst and Cervical Sinus were drawn by Mr F Price]

Bibliography

Bailey H. (1933). *Brit J Surg* **21**, 173
Gross, R. E. (1953). *Surgery of Infancy and Childhood*, p 947 Philadelphia Saunders.
Wilson, C. P (1955). *Ann. Roy Coll. Surg Eng* **17** 1

CAROTID BODY TUMOUR

B McN Truscott, M.B.E., M.A., M.B., F.R.C.S.
Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

Carotid body tumours are seen as slowly growing lumps in the neck in middle-aged patients In the vas of cases they are entirely asymptomatic. They may present for removal in two ways diagnosed corr operatively or discovered at operation when the pre-operative diagnosis has been that of a branchial cy tumour at this site If diagnosed pre-operatively the indications for removal are threefold the presence of the neck which annoys the patient, the possibility of pressure on surrounding structures, the possibility of change This last indication is open to doubt. Willis (1958) states that he has yet to be convinced that thes are either locally invasive or metastasize. Lahey and Warren (1951) come to the conclusion that, while change is possible, it is much less common than formerly believed.

These tumours are entirely radio-resistant

Special contra-indications

The great danger in removal of these tumours is cerebral damage if the common or internal carot require ligation or removal A mortality rate of 40 per cent can be expected if this has to be done. arterial grafts has altered the whole prognosis It would seem right to stipulate that removal of a car tumour should not be undertaken if diagnosed pre-operatively unless facilities are to hand for replacing segment of the internal or common carotid arteries by a graft. If, however on exploring the neck on a diagnosis a small tumour is found which is not surrounding the carotid bulb it would seem reasonable t to removal without grafting facilities being present

Position of patient

The patient should be in the supine position with a pillow beneath the shoulders to extend the neck. Ti the table is raised as described in operations for branchial cyst. The point of the chin is turned away affected site.

Towelling

The towelling is the standard method used for operations on the neck.

Anaesthesia

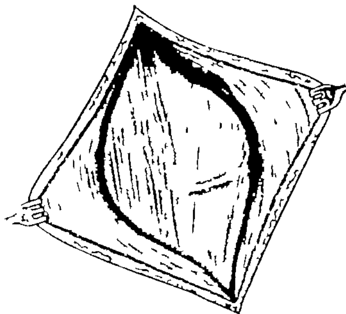
A general anaesthetic through an endotracheal tube is used.

THE OPERATION



The incision

A vertical incision is made along the line of the anterior border of the sternomastoid from the mastoid process to the sternum and it must be a generous one to allow wide exposure of the common carotid below the incision and the internal and external carotid arteries above the lesion.



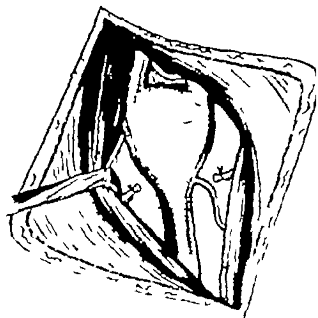
Skin flaps

2 Skin, subcutaneous fat and platysma are dissected from the underlying structures and retracted medially as far as the midline and laterally to the posterior border of the sternomastoid.

3

Exposure of the carotid sheath

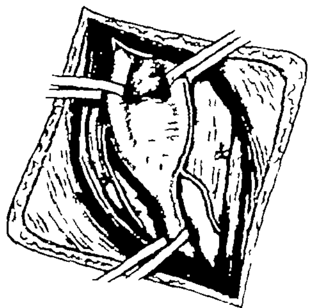
The anterior border of the sternomastoid is separated from the cervical fascia throughout the length of the wound. The muscle is retracted laterally. The deep cervical fascia is divided to expose the carotid sheath. Veins running anterior to the carotid arteries to the internal jugular vein are divided between ligatures and the internal jugular vein is retracted laterally. The vagus nerve is retracted with the vein. The hypoglossal nerve is exposed running transversely in the upper part of the wound.



4

Isolation of the common carotid, the external carotid and the internal carotid arteries

At the lower end of the wound below the tumour the common carotid artery is isolated and dissected clear of its bed. A tape is passed round the artery. At the upper end of the wound the external and internal carotid arteries are dissected clear and tapes passed round each artery. To aid mobilization of the external carotid artery the superior thyroid artery may be ligated.



Removal of the tumour

5 By mobilization of the arteries and traction with the tapes it should now be possible to assess whether the tumour can be removed without ligating the common carotid artery

Freeing the deep surfaces

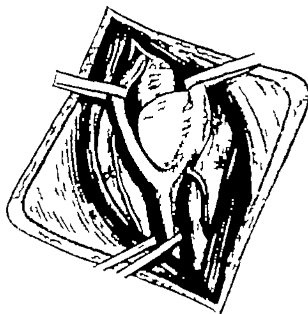
Traction on the three tapes in a lateral direction will tend to lift the tumour from its bed. It should then be dissected until clear of this bed.

Separation of carotid fork

If the tumour has been separated from its bed it can be lifted from the wound and removal from the carotid fork is started. This is rendered easier by separation of the internal and external carotid arteries by traction on the tapes. The carotid fork is normally a narrow angle and this separation makes dissection of the tumour from the walls of the arteries much easier

Dissection of the tumour from the internal carotid artery

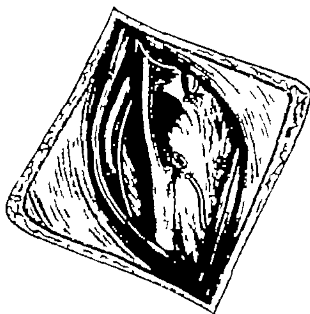
The plane of cleavage between the tumour and the wall of the internal carotid artery is determined but adventitia of the artery itself may be taken. In my view it must be accepted at this stage that the operation should be discontinued if there is danger of damage to the internal carotid artery and grafting facilities are not present. The dissection is continued until the tumour is free of the internal carotid artery and its junction with the common carotid artery When this is complete attention is transferred to the external carotid artery



Removal from the external carotid artery closure of the wound

6 Dissection in the plane of cleavage between the tumour and the external carotid artery is carried out as for the internal carotid artery If, however it proves difficult the artery may be ligated above the carotid bulb and above the tumour and a section of the artery removed with the tumour

The deep cervical fascia is repaired with a continuous catgut suture and the wound closed with clips or interrupted sutures. A drain is not required.



[*The illustrations for this Chapter on Carotid Body Tumour were drawn by Mr F Price*]

References

Lahey F H and Warren, K. W (1951). A long-term appraisal of carotid body tumours, with remarks on their removal." *Surg Gynec. Obstet.*, 48, 481–491

Willis, R. A. (1953). *Pathology of Tumours*, 2nd ed., p. 875. London Butterworth.

EXCISION OF PHARYNGEAL POUC

B McN Truscott M.B.E., M.A., M.B., F.R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

The symptoms in order of occurrence which require relief are a feeling of food sticking in the throat, regur tion of undigested food, noisy deglutition and lastly but most important, dysphagia, which may reach a de which causes malnutrition.

In the case of a small pouch increase in size may be delayed by repeated oesophageal dilatation, but this is a porary expedient. A further indication for removal of the pouch is the possibility of development of an epitheli in the sac.

Contra-indications

The only special contra-indication is when malnutrition is sufficient to make removal dangerous before patient's general condition has been improved.

Pre-operative preparation

Where dysphagia has caused inanition or dehydration this can be improved by 7 days feeding throug indwelling Ryle's tube using a high-caloric, high-vitamin containing feed. In cases of extreme starvati gastrostomy 2 weeks before excision of the pouch should be done 48 hours before operation the pouch shoul washed out twice daily

Anaesthesia

The anaesthetic is given through a cuffed endotracheal tube After passage of the tube the pouch shoul emptied by suction and a full-sized oesophageal bougie passed.

Position

The patient lies in the supine position with a pillow under the shoulders to extend the neck. The chin is tur towards the opposite side and the table tilted to raise the head, neck and thorax 80 degrees from the horizo plane. This position is maintained by holding the patient in a canvas sheath (*see* Branchial Cyst and Cervical Su page 84)

THE OPERATION

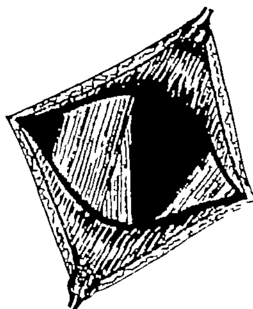
Incision

1 A transverse incision is made in the line of a skin crease at the level of the cricoid cartilage. In cases where the pouch is of a large size a vertical incision down the edge of the sterno-mastoid can be used This allows longer and greater exposure at the lower,end of the neck



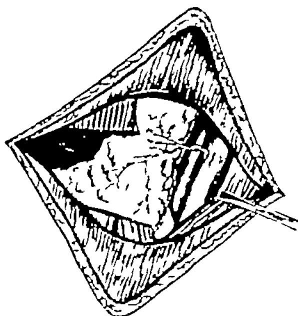
Exposure of infra-hyoid muscles

2 The skin flaps, including the subcutaneous fat and platysma, are dissected upwards and downwards and then retracted. The attachment of the cervical fascia to the sterno-mastoid muscle is separated throughout the length of the wound and that muscle retracted laterally The sterno-hyoid, sterno-thyroid and omo-hyoid muscles are cleaned and defined.



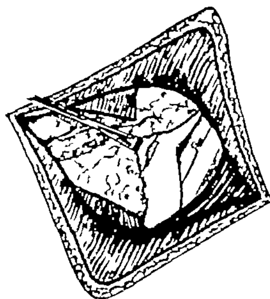
3 **Division of infra-hyoid muscles**

The sterno-thyroid and sterno-hyoid muscles are divided and dissected off the underlying thyroid gland. They are retracted upwards and downwards. The omo-hyoid muscle is also divided and retracted upwards and downwards. This exposes the underlying lateral lobe of the thyroid gland.



4 **Mobilization of thyroid gland**

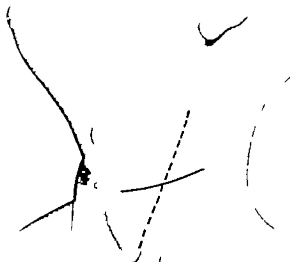
The middle thyroid vein is defined and divided between ligatures. The lateral border of the thyroid gland is separated by blunt dissection from the deep structures of the neck and retracted medially lifting the lobe from its bed and exposing the pharyngeal pouch



THE OPERATION

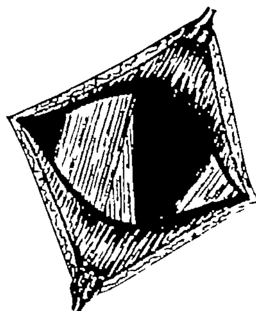
Incision

1 A transverse incision is made in the line of a skin crease at the level of the cricoid cartilage. In cases where the pouch is of a large size a vertical incision down the edge of the sterno-mastoid can be used. This allows longer and greater exposure at the lower end of the neck



Exposure of infra-hyoid muscles

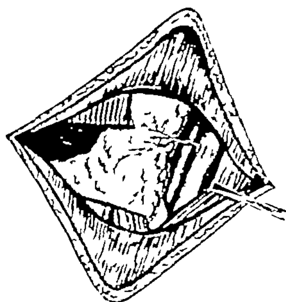
2 The skin flaps, including the subcutaneous fat and platysma are dissected upwards and downwards and then retracted. The attachment of the cervical fascia to the sterno-mastoid muscle is separated throughout the length of the wound and that muscle retracted laterally. The sterno-hyoid, sterno-thyroid and omo-hyoid muscles are cleaned and defined.



3

Division of infra-hyoid muscles

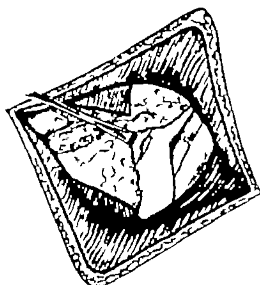
The sterno-thyroid and sterno-hyoid muscles are divided and dissected off the underlying thyroid gland. They are retracted upwards and downwards. The omo-hyoid muscle is also divided and retracted upwards and downwards. This exposes the underlying lateral lobe of the thyroid gland.



4

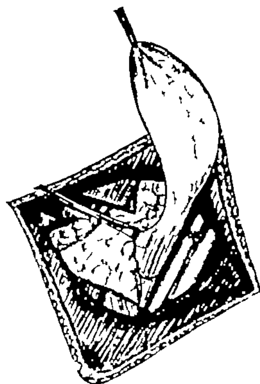
Mobilization of thyroid gland

The middle thyroid vein is defined and divided between ligatures. The lateral border of the thyroid gland is separated by blunt dissection from the deep structures of the neck and retracted medially lifting the lobe from its bed and exposing the pharyngeal pouch.



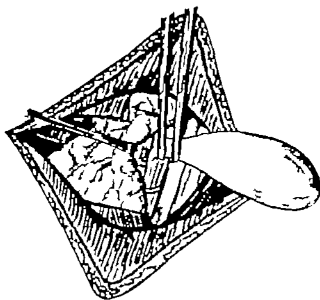
Identification and dissection of the pouch

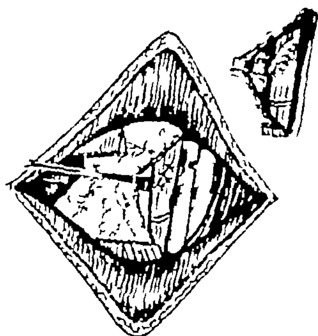
5 The pouch will be found lying behind the thyroid gland, lateral to the trachea and medial to the internal carotid artery and jugular vein. Its lower portion is dissected free of surrounding structures by blunt dissection. It is then grasped by forceps and gentle traction made in an upward direction The pouch is dissected clear by blunt dissection until it is entirely free except at the point where its neck enters the wall of the pharynx. The inferior thyroid artery may be seen running medially in the depths of the wound.



Removal of pouch

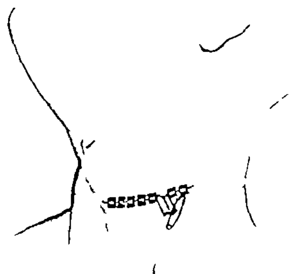
6 Forceps are applied to the neck of the pouch approximately 0 5 cm. from its attachment to the wall of the pharynx. The pouch is removed by cutting between these forceps, leaving the neck of the pouch secured by the proximal forceps. The neck is then closed by a continuous inverting suture of 000 plain catgut applied over the forceps and tightened when the forceps are removed.





Repair of defect

7 The gap in the muscle wall of the pharynx at the site where the pouch protruded is repaired by interrupted sutures of fine silk or linen thread, drawing together the edges of the muscle.



Wound closure

8 A thin strip of corrugated rubber drain is placed with one end down to the site of the pouch and its other end is brought out anterior to the sterno-mastoid at the posterior end of the skin incision. The infra-hyoid muscles are then brought together again with a continuous fine catgut suture. The skin flaps are closed by a continuous catgut suture to the platysma and interrupted clips or sutures as required.

POST-OPERATIVE CARE AND COMPLICATIONS

A sedative linctus should be given liberally as required for the first 8 days to relieve any irritative cough. A full course of antibiotics should be given pre-operatively and continued for at least 7 days after operation. The drain is removed on the third day alternate clips on the fourth day and the remainder of the clips on the fifth day The patient should become ambulatory after 5 days.

Feeding

Fluids are administered through an indwelling Ryle s tube for 48 hours. At this time the tube is removed and the diet is restricted to fluids or thickened feeds for a further 14 days.

Fistula

This may be expected in 5 per cent of cases. It will heal spontaneously in 8–12 weeks.

Mediastinitis

Prior to the use of antibiotics, mediastinitis was a feared and commonly fatal complication For this reason the two-stage operation was practised. The complication is now most infrequent and can best be avoided by careful pre-operative correction of inanition by careful closure of the neck of the pouch, and by the use of antibiotics both before and after operation.

Post-operative stricture

Encroachment on to or borrowing from the pharyngeal wall when closing the neck of the pouch may give rise to a stricture at this site. A full-sized oesophageal bougie passed after the anaesthetist has passed the cuffed endotracheal tube will help to prevent this mistake by showing the size required of the pharynx.

[*The illustrations for this Chapter on Excision of Pharyngeal Pouch were drawn by Mr F Price*]

Bibliography

Lahey F H. (1946). *Ann. Surg.*, **124**, 617
Mosley J (1945). *Brit J Surg.*, **33** 101
Sweet, R. H. (1947). *Ann Surg.*, **125** 41

TRACHEOSTOMY

B McN Truscott M B E., M.A., M B., F R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

Obstruction to the respiratory passage is the main indication for tracheostomy Obstruction may be acute as seen in the impaction of a large foreign body oedema of the glottis, or acute laryngeal infections, or it may be progressive as in new growths and bilateral abductor palsy of the cords.

Recently an additional indication has been found in cases of acute bulbar poliomyelitis or prolonged coma, as seen in severe head injuries. The aim of the tracheostomy here is to maintain an adequate airway to prevent the aspiration of oesophageal contents or nasal and oral secretions and to allow ready aspiration of retained bronchial secretions.

In prolonged and severe inflammatory conditions of the larynx as in tuberculosis, tracheostomy may be necessary to rest the infected area. This indication has become less important since the institution of chemotherapy

Special equipment

For ordinary cases a silver tracheostomy tube with an introducer suitable to the age and size of the patient will be required. For the paralysed or unconscious patient, where the aim is to prevent aspiration into the trachea, a cuffed tracheostomy tube is used.

In bulbar poliomyelitis the possibility of an added respiratory palsy must be borne in mind and arrangements made to continue artificial respiration either by a respirator of the Drinker type or by a positive pressure respirator

Anaesthesia

Local anaesthesia is the anaesthetic of choice This will not be necessary where tracheostomy is performed as an urgent procedure on an unconscious patient, and will not be suitable in conscious, but young children such cases will require a general anaesthetic. General anaesthesia is also to be preferred when tracheostomy is performed for bulbar poliomyelitis it allows a more rapid and effective toilet of the trachea prior to inserting the tracheostomy tube

Fifty *ml* of 1 per cent Nupercaine are placed in the superficial tissues over the trachea 5 ml. is injected deeply beside the trachea on each side. When the trachea is exposed 0·2 ml of 5 per cent cocaine is injected into the lumen in an interval between the *tracheal rings*.

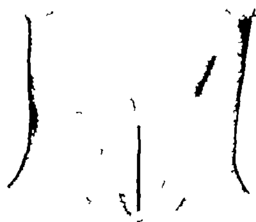
Position of patient

The patient is placed flat on his back with sufficient pillows under the shoulders to extend the neck fully The most important point in positioning is that the chin should be exactly in the *midline* Deviation of the chin to one side or the other may make identification and exposure of the trachea difficult It is achieved by lining up the chin, the point of the thyroid cartilage and the *suprasternal notch*

THE OPERATION

The incision

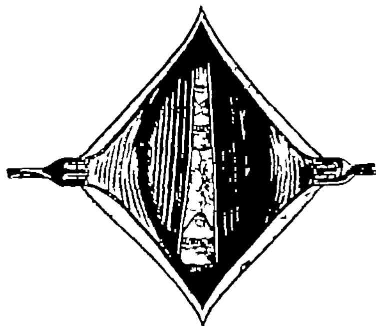
1 Contrary to the usual practice in the neck a vertical incision is made in the midline from the lower border of the thyroid cartilage to the suprasternal notch. The greater speed and better exposure given by a vertical incision more than compensates for a scar which may be more obvious than if a transverse incision was made. Neither incision can give a perfect cosmetic result.



Skin flaps

2 The incision is carried down through the superficial fascia and deep fascia of the neck to the level of the infrahyoid muscles.

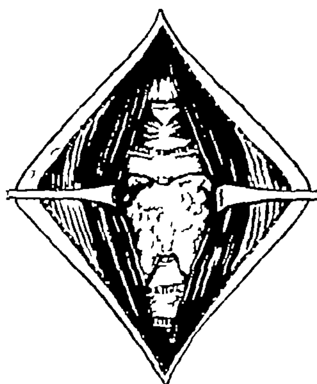
Flaps of skin, platysma and deep cervical fascia are lifted off the underlying muscle by dissection until an area equal to the whole width of the trachea is exposed. These flaps are then retracted laterally exposing the infrahyoid muscles.



Exposure of the trachea

3 The interval between the infrahyoid muscles is identified and the medial border of each of these muscles dissected free of the underlying tissues. These muscles are then retracted laterally exposing the isthmus of the thyroid gland.

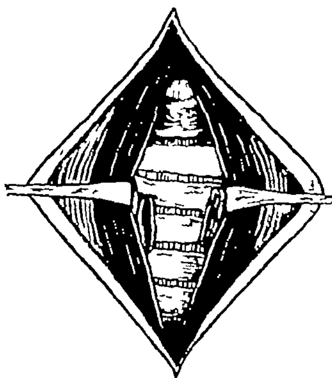
The cricoid cartilage and first ring of the trachea will be exposed above and several rings of the trachea below the isthmus. Dissection and subsequent retraction of the infrahyoid muscles should be sufficient to expose the underlying structures throughout the whole length of the wound.

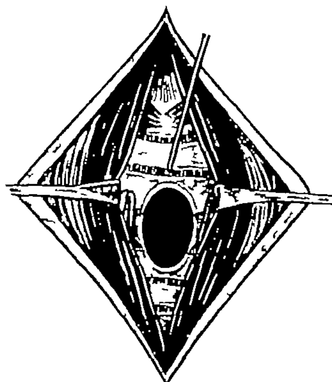


Division of the isthmus

4 The plane between the isthmus of the thyroid gland and the trachea is found by blunt dissection and the isthmus is freed, clamped between forceps and divided between ligatures.

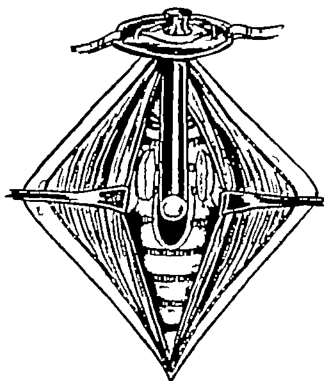
The separated lobes of the thyroid gland can then be displaced laterally by gentle stripping. The cricoid cartilage and trachea will be clearly exposed and identification of the various rings made simple.





Incision into the trachea

5 The trachea is steadied by upward traction on the cricoid cartilage. A small oval of cartilage is removed with the knife, taking portions of the second, third and fourth rings of the trachea and leaving an opening measuring 1 5 by 1 cm. in an adult. The size in an infant or child will naturally vary according to the size of the trachea.

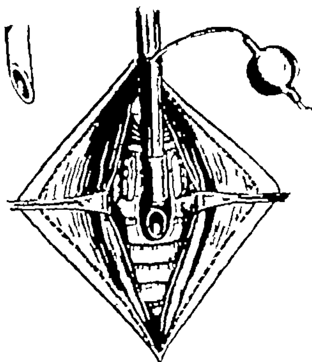


Introduction of the tracheostomy tube

Silver

6 After aspiration of mucus a silver tracheostomy tube of suitable size mounted on an introducer is put into the trachea. The introducer is removed leaving the tube *in situ*

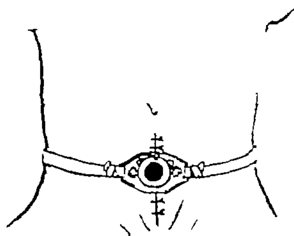
Two factors will influence the choice of size of tube width or calibre and length. The widest tube which will fit snugly into the opening in the trachea should be used but it should not be so wide as to require any force for introduction. The tube should also be long enough to allow the flange to rest comfortably on the wound after closure of the skin.



7 *Cuffed rubber tube*

When its use is indicated the cuffed tube is slipped into the tracheostomy opening no introducer is required When the tube is in the correct position the cuff is inflated with sufficient pressure to hold the tube lightly but firmly in position

The widest tube that will fit into the trachea comfortably should be used The portion of tube below the cuff should be cut as short as possible to avoid entering one main bronchus and obstructing the other



Closure of wound and maintenance of the tube in position

8 The upper and lower limits of the incision are approximated with interrupted silk sutures leaving the skin fitting snugly but not tightly round the tube.

A silver tube is held in position with tapes round the back of the neck. The position of the cuffed tube is maintained either by the special clip provided with the tube or by tapes tied round the tube.

POST-OPERATIVE CARE

If artificial respiration is used with a tracheostomy the following points require attention. The air entering the trachea must be warmed and humidified A constant check must be kept to ensure the delivery of the right amount of air at the correct rate and pressure Frequent clinical and radiological checks are required to ensure that the whole lung field is being aerated. Any collection of fluid in the bronchial tree must be aspirated this may have to be done through a bronchoscope. Regular blood pressure readings are required A persistent rise will suggest an increase in the blood CO_2 level The cuff should be let down for one minute every four hours

[The illustrations for this Chapter on Tracheostomy were drawn by Mr F Price]

Bibliography

Davis, M. V (1954). "Digestive Treatment." *Amer Practit* 5 231
Lassen, H. C. A. (1953) *Lancet* 1, 37
Walford, A S H., and Spalding J M K. (1955) *Proc R Soc Med.*, 48, 917

OPERATION FOR CERVICAL RIB

B McN Truscott M.B.E., M.A., M.B., F.R.C.S

Surgeon to the United Cambridge Hospitals

PRE-OPERATIVE

Indications

Under the term cervical rib is included the group of conditions known as the scalenus anticus syndrome which produce pressure effects on the neurovascular bundle as it leaves the upper thoracic inlet.

The indications for surgery are cases in which there is evidence of pressure on the subclavian artery as shown by transient attacks of blanching and blueness of the fingers or even embolic phenomena, or on the lower cord of the brachial plexus by paraesthesiae and wasting of the hypothenar eminence of the hand. Cases with slight symptoms of short duration, particularly in patients who have recently undertaken heavy work involving a lifting strain on the shoulder girdle, can be treated conservatively If the pressure symptoms are severe, then surgical removal of the cause will be required. This cause will be some abnormality of the bones or muscles of the cervico-axillary canal, such as a cervical rib a fibrous band in the anatomical situation of a cervical rib an abnormality of the insertion of the scalenus medius muscle into the first rib or an abnormality of the first rib itself

Anaesthesia

General anaesthesia through an endotracheal tube is the anaesthetic of choice. As in all operations on the neck particular attention should be paid to the avoidance of any expiratory obstruction

Position

The patient is placed in a supine position with a pillow under the shoulders to allow extension of the neck. The head is turned to the other side to widen the supraclavicular triangle. The head and trunk are raised by tilting the upper half of the table to an angle of 80 degrees from the horizontal.

Towelling

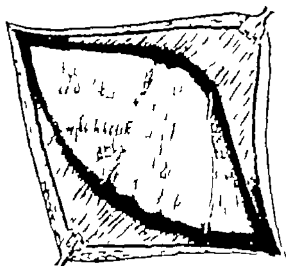
One towel is placed under the shoulders, the neck and the head. Another is wrapped round the head, extending from the occiput to the point of the chin. A further towel is carried down from the point of the chin in the midline of the neck across the xiphisternum. A sheet is then placed with its upper border just below the clavicle

THE OPERATION



The incision

1 A transverse incision is made one finger's breadth above the clavicle extending medially from just medial to the edge of the sterno-mastoid muscle and laterally to the anterior border of the trapezius.

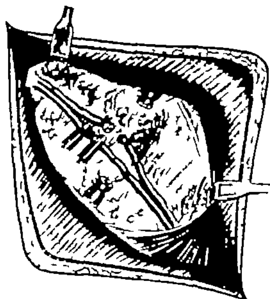


Skin flaps

2 The skin, subcutaneous fat and platysma are dissected upwards and downwards. In this dissection the external jugular vein and the clavicular branches of the cervical plexus will be discovered. For ease of exposure the external jugular vein can be divided between ligatures. The clavicular branches of the cervical plexus should be preserved and retracted to allow exposure

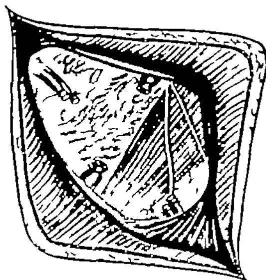
Definition of sternomastoid and omohyoid muscles

3 The lateral border of the sternomastoid muscle will be found at the medial edge of the wound. It should be defined, freed and retracted medially. The omohyoid muscle will be found running across the wound from below upwards and medially. Both borders of this muscle should be defined and cleaned and the muscle retracted. The transverse cervical vessels will now be seen running across the wound. They should be isolated and divided between ligatures.



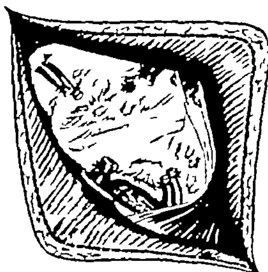
Definition of scalenus anterior muscle and phrenic nerve

4 The scalenus anterior muscle will be found lying beneath the retracted sternomastoid muscle. Its lateral border should be defined and dissected free of the subcutaneous fat in the supra-clavicular triangle. Running on the anterior surface of this muscle the phrenic nerve should be identified and retracted medially.



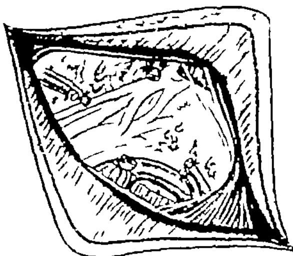
Division of the scalenus anterior

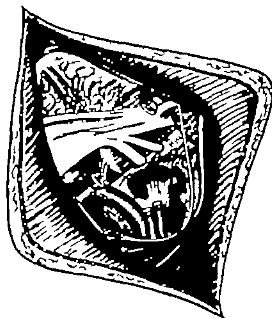
5 After retraction of the phrenic nerve the scalenus anterior muscle is divided to allow improved exposure of the underlying structures. Care should be taken to avoid injury to the subclavian artery which is an immediate posterior relation



Exposure of subclavian artery and brachial plexus

6 With the division of the scalenus anterior muscle, the subclavian artery and brachial plexus can be fully exposed. The subclavian artery should be cleaned and separated from the lower cord of the brachial plexus. Any adhesions between this cord and the artery should be divided completely The cords of the brachial plexus should be isolated and defined throughout the whole length of the wound.



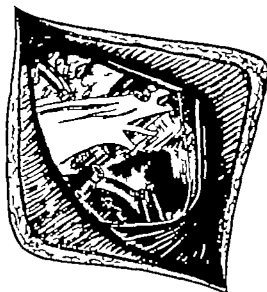


Mobilization of the lowest cord of the brachial plexus

7 The lowest cord of the brachial plexus should now be lifted from its bed starting at the medial edge and working laterally Any structures found tethering this cord to its bed should be divided and the cord is then lifted free of its bed, displaying the underlying cervical rib

Removal of the chafing structure

The cervical rib is cleaned of all muscle attachments and mobilized from before backwards. When free the rib is removed complete



Replacement of the cord

8 After removal of the cervical rib the cord is allowed to sink back on its bed. It is important to make sure at this stage that there is no irregularity of that bed. The insertion of the scalenus medius muscle to the first rib is inspected and if the tendinous insertion has a sharp edge that edge is removed. If in doubt a small portion of the first rib itself may be nibbled away

The platysma is sutured with a running catgut suture and the wound closed with clips. No drainage is required.

POST-OPERATIVE CARE

Active movements of the fingers wrist, elbow and shoulder joints are encouraged from the first post-operative day Alternate clips are removed on the fourth post-operative day and the remainder 24 hours later

[The illustrations for this Chapter on Operation for Cervical Rib were drawn by Mr F Price]

Bibliography

Falconer M. A., and Weddell, G (1943). *Lancet*, **2**, 539
Walshe, Harvey Jackson, and Wyburn Mason (1944) *Brain*, **67** 141

CARCINOMA OF THE PHARYNX

RONALD W. RAVEN, O.B.E., T.D., F.R.C.S.

Surgeon, Westminster (Gordon) Hospital, London; Surgeon, The Royal Marsden Hospital, London

PRE-OPERATIVE

CARCINOMA OF THE OROPHARYNX

PARTIAL PHARYNGECTOMY

Indications

Partial pharyngectomy is indicated for carcinoma of the tonsil, faucial pillar or pharyngeal wall.

Special pre-operative preparation

Special pre-operative preparation includes the extraction of carious teeth, treatment of pyorrhoea alveolaris, treatment of respiratory infection and breathing exercises.

Anaesthesia

Pre-medication

Depending upon the age and physical condition of the patient $\frac{1}{3}$ gr. (20 mg.) Omnopon and $\frac{1}{150}$ gr. (0·4 mg.) scopolamine are injected hypodermically 1 hour before the operation. In patients over 60 years of age the doses given are $\frac{1}{6}$ gr. (10 mg.) Omnopon and $\frac{1}{300}$ gr. (0·2 mg.) scopolamine. When the patient is frail or over 75 years of age scopolamine is omitted for it may produce restlessness; then $\frac{1}{100}$ gr. (0·6 mg.) atropine is injected hypodermically 20 minutes before induction.

Administration

Induction.—10 ml. thiopentone (5 per cent solution) is injected intravenously followed by 1–2 ml. (50–100 mg.) scoline. In the aged a 2·5 per cent solution of thiopentone is advisable. A mask is then placed over the face and oxygen (100 per cent) is administered until the patient is relaxed by the scoline. An endotracheal tube with inflatable cuff, lubricated with Compound Cinchocaine ointment (5 per cent cinchocaine base) is introduced into the trachea by direct laryngoscopy. The cuff is inflated and the tube is connected to the anaesthetic machine with nitrous-oxide gas and oxygen flowing. Several more millilitres of thiopentone may be needed now to settle the patient.

Maintenance.—Anaesthesia is maintained with nitrous-oxide and oxygen. Pethidine hydrochloride (20–40 mg. up to a maximum total dose of 100 mg.) may be injected intravenously.

Dextrose-saline solution is administered intravenously by the drip method; a pint of blood can be given if required but blood loss is minimal in amount. A record is kept of the blood-pressure and pulse rate. Accumulation of carbon dioxide is prevented by adequate pulmonary ventilation with oxygen.

Position of the patient

The patient lies supine with a low pillow placed between the scapulae; the head is extended by lowering the head-piece of the table, and rotated to the opposite side. The whole table is tilted to 40 degrees in the reverse Trendelenburg position to minimize venous congestion of the head and neck.

Arrangement of towels

The skin of the neck, upper third of the anterior chest wall and face is prepared in the usual way and two towels with a sheet of jaconet are placed under the head. The top towel is then folded to enclose the head and part of the

face, its lower border being 5 cm above the angle of the mandible. Another towel is placed over the chest wall whose upper border is at the manubrium sterni Lateral towels are placed on the neck and the rest of the patient is covered.

PARTIAL PALATO-PHARYNGECTOMY

This is indicated where carcinoma of the oropharynx extends into the soft palate.

PARTIAL GLOSSO-PHARYNGECTOMY

This is the operation of choice when carcinoma of the oropharynx extends into the posterior third of the tongue.

PARTIAL PALATO-GLOSSO-PHARYNGECTOMY

This is indicated where carcinoma of the oropharynx extends into the soft palate and the posterior third of the tongue.

CARCINOMA OF THE HYPOPHARYNX

LARYNGO-PHARYNGECTOMY AND LARYNGO-OESOPHAGO-PHARYNGECTOMY

Laryngo-pharyngectomy is the operation for removal of the larynx and the hypopharynx including the hyoid bone and the pharyngo-oesophageal junction. Laryngo-oesophago-pharyngectomy is the operation for removal of the larynx, hypopharynx and the cervical oesophagus, including the hyoid bone.

Indications

Carcinoma of the hypopharynx which involves more than half its circumference carcinoma of the posterior wall of the hypopharynx carcinoma of the hypopharynx which involves the cervical oesophagus multifocal carcinoma of the hypopharynx carcinoma of the cervical oesophagus where the oesophagus can be divided at the thoracic inlet 1·25 cm. below the lower edge of the growth carcinoma of the larynx with extensive involvement of the hypopharynx carcinoma of the hypopharynx which is uncontrolled by radiotherapy and still operable. The construction of a skin hypopharynx in these latter cases requires a series of operations and the use of acromio-pectoral tubed pedicle skin grafts.

Special pre-operative preparation and anaesthesia

Extraction of carious teeth and the treatment of oral sepsis are necessary When complete dysphagia has lasted for a few days a temporary gastrostomy is instituted to improve the patient s nutrition for three weeks before the major operation. Breathing exercises should be instituted. The position of the patient and the arrangement of towels are as for partial pharyngectomy Anaesthesia (pre medication administration, induction and maintenance) is identical with that described for partial pharyngectomy

LARYNGO-PARTIAL PHARYNGECTOMY

Indications, pre-operative preparation, and anaesthesia

This operation is indicated where carcinoma is localized in the pyriform fossa, in the anterior wall of the hypopharynx, or to the arytenoid

The special pre-operative preparation is as for laryngo-pharyngectomy Anaesthesia (pre-medication administration, induction and maintenance) is identical with that described for partial pharyngectomy

CARCINOMA OF THE OROPHARYNX

PARTIAL PHARYNGECTOMY

Incision and reflection of skin flaps

1 This commences on the affected side at the tip of the mastoid process and curves forwards 2·5 cm below the angle of the mandible to the midline of the neck 5 cm below the symphysis menti. It is continued down the mid-line to 1 cm above the suprasternal notch.

The posterior skin flap is reflected off the platysma as far as the anterior border of the trapezius. The superior flap is reflected up to expose the outer aspect of the horizontal ramus and angle of the mandible and the lower pole of the parotid salivary gland

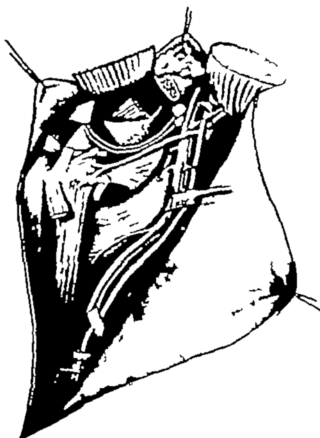


Block dissection of the cervical lymphatics

Starting at the root of the neck the following structures are excised the platysma and the deep cervical fascia from the mid-line to the anterior border of the trapezius the sterno-mastoid, omohyoid, posterior belly of the digastric and stylohyoid muscles internal jugular vein spinal accessory nerve and upper and lower groups of the deep cervical lymph nodes as high as the base of the skull. The tissues are left attached to the oropharynx and removed later with the primary carcinoma as a monoblock operation.

Mobilization of the oropharynx

2 The oropharynx with the carcinoma is mobilized, the stylopharyngeus muscle being excised and the hypoglossal, glosso-pharyngeal and facial nerves identified and conserved. The ascending pharyngeal artery is then ligated and divided. The superior constrictor muscle is detached from the inner aspect of the mandible and the internal pterygoid plate and the oropharynx is separated from the prevertebral fascia. The angle of the mandible is cleared of muscle and resected. The oropharynx is opened at a point 2·5 cm. below the carcinoma and above the superior cornu of the hyoid bone the exact limits of the growth can now be palpated



Excision of the carcinoma

3 The carcinoma is excised with the scalpel under direct vision by an encircling incision through a normal area of the pharyngeal wall at least 2 5 cm. from the edge of the growth This part of the wall of the oropharynx with the growth and its attached lymph nodes is then removed. Any small bleeding vessels are sealed with diathermy



Reconstruction of the oropharynx

4 An inner lining of mucous membrane and outer skin cover must be obtained. If there is sufficient mucous membrane a primary closure with interrupted sutures of catgut (No 0) without tension, is reinforced by suture of the fibro-muscular tissue in the vicinity over it. If, however there is not sufficient pharyngeal mucous membrane available, the soft palate can be mobilized and drawn over to the defect, or a quadrilateral flap of mucous membrane can be reflected off the dorsum of the tongue with its base attached postero-laterally and the defect in the oropharynx closed with this.

A temporary tracheotomy should then be instituted. The skin is sutured with interrupted fine nylon sutures, a soft rubber drain is inserted down to the pharyngeal wound and another in the lower part of the neck. A Ryle s tube is passed through the nose into the lower end of the oesophagus for feeding purposes.

OTHER PROCEDURES

Partial palato-pharyngectomy —Most of the affected half of the soft palate is removed in addition. When there is insufficient pharyngeal mucous membrane available to close the defect, a mucous membrane flap from the dorsum of the tongue is used.

Partial glosso-pharyngectomy —Part of the substance of the tongue is excised in addition to include any deep infiltration. When there is insufficient mucous membrane of the oropharynx available or the defect cannot be closed by utilizing the soft palate, a flap of mucous membrane raised from the tongue anterior to the area excised and based on the lateral margin is swung posterolaterally into the defect.

Partial palato-glosso-pharyngectomy —The technique is as described, and a flap of mucous membrane from the tongue may well be needed to close the pharyngeal defect.

CARCINOMA OF THE HYPO-PHARYNX

LARYNGO-PHARYNGECTOMY AND LARYNGO-OESOPHAGO-PHARYNGECTOMY

The excisional and the first part of the reconstructional stages are done at the same time 6 weeks are allowed before the second part is done

EXCISIONAL STAGE

The incisions

5 A quadrilateral skin flap based on the sternomastoid not being removed is marked out on the neck. The upper horizontal incision crosses the neck from the anterior border of one sternomastoid muscle to the anterior border of the opposite sternomastoid muscle at the level of the hyoid bone The lower horizontal incision crosses the neck 1 5 cm. above the suprasternal notch from the sternal head of the sternomastoid muscle not being removed to the middle of the opposite sternomastoid muscle The extremities of these incisions are connected by a vertical incision.

On the side of the radical lymph node dissection an upper oblique incision passes from the upper extremity of the quadrilateral flap to the tip of the mastoid process and a lower oblique incision to the posterior border of the clavicular attachment of the sternomastoid.



Skin flaps

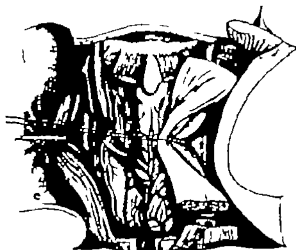
6 The quadrilateral skin flap is reflected off the platysma to the anterior border of the sternomastoid which is not being removed and is covered by hot packs throughout the operation. The skin in the submandibular region is undermined for a distance of 8 5 cm. The posterior skin flap is reflected off the sternomastoid muscle which is to be removed as far as the anterior border of the trapezius muscle The skin covering the lower part of the neck is undermined for 2 5 cm below the suprasternal notch

The regional lymph nodes are examined the mobility of the cervical oesophagus, thyroid gland and other structures is determined



Block dissection

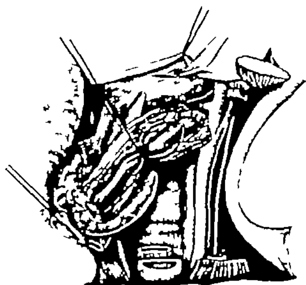
7 A radical block dissection of the lymphatics is performed on the side of the neck where the lymph nodes are larger these tissues are left attached to the hypopharynx. The lymph nodes in the opposite side are dissected out and left attached to the hypopharynx. The lymph nodes along both recurrent laryngeal nerves are removed separately



Mobilization of the hypopharynx, pharyngo-oesophageal junction and cervical oesophagus

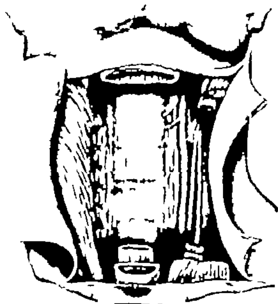
8 The origins of the sternothyroid and sternohyoid and the posterior belly of the omohyoid muscles are divided. The following blood vessels are ligated and divided the anterior and external jugular veins, the middle and inferior thyroid veins and the superior and inferior thyroid arteries. The superior and recurrent laryngeal nerves are next divided. By blunt dissection the posterior wall of the hypopharynx is separated from the prevertebral fascia to 1 5 cm. above the body of the hyoid bone The pharyngo-oesophageal junction is mobilized and when the cervical oesophagus is infiltrated this is mobilized to the thoracic inlet. When the carcinoma is situated in the upper part of the hypopharynx the trachea is divided between the second and third rings, and when it is in the lower part between the third and fourth rings, or lower if required.

The endotracheal tube with inflatable cuff is divided as high as possible in position the distal end is connected with the anaesthetic apparatus. A 2 5 cm. incision is made in the suprasternal skin flap the divided trachea is passed through and sutured in position.



Division of the pharyngo-oesophageal junction or cervical oesophagus

9 When the carcinoma is in the upper part of the hypopharynx the pharyngo-oesophageal junction is divided. If the cervical oesophagus is involved this structure is divided at the thoracic inlet at least 1·2·5 cm below the lower edge of the growth



Division of the upper end of the hypopharynx

This is carried out immediately above the body of the hyoid and the mucous membrane covering the upper surface of the epiglottis is conserved for the reconstruction the remainder of the epiglottis is removed

When the upper limit of the carcinoma is not certain the hypopharynx is opened through a normal area so that the interior can be inspected and the division made at least 2 cm from the edge of the growth. If there is any doubt concerning satisfactory clearance an immediate histological examination of the wall is made by the frozen section technique.
All the thyroid blood vessels have been ligated and divided and the gland is removed with the hypopharynx.

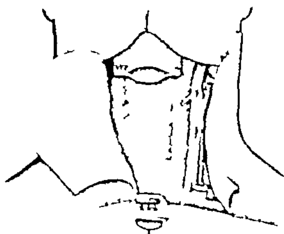
RECONSTRUCTIONAL STAGE

First phase.—*This is done at the same operation as the excisional stage*

The remaining sternomastoid is sutured to the prevertebral fascia with interrupted catgut sutures.

Formation of the posterior wall of the skin hypopharynx

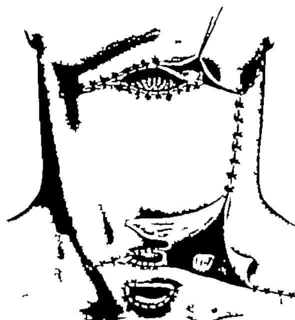
10 The diameter of the pharyngeal stoma is reduced to 5 cm by suturing the mucous membrane of the anterior and posterior walls of the lateral portions with interrupted sutures of catgut (No 0) The quadrilateral skin flap is then laid across the neck over the prevertebral tissues.



Anastomosis of the skin flap with the oesophagus and hypopharynx

11 The posterior wall of the oesophagus is anastomosed with the adjacent lower border of the quadrilateral skin flap with interrupted sutures of fine nylon alternating with catgut (No 0) placed 0·8 cm. apart. These sutures pass through all coats of the oesophageal wall. The suprasternal skin flap posterior to the tracheostomy is anastomosed to the anterior wall of the cervical oesophagus similarly

The posterior wall of the divided hypopharynx is sutured similarly to the adjacent upper border of the quadrilateral skin flap The anterior wall of the hypopharynx is sutured to the adjacent part of the submandibular skin flap. The free edge of the quadrilateral skin flap is sutured to the skin of the opposite side and the remaining skin edges are sutured. A small drainage tube is inserted through the postero-inferior part of the wound on the side of the radical lymph node dissection. A polythene tube is passed through the oesophagostomy into the lower end of the oesophagus for feeding purposes. A tube is inserted in the tracheostomy and the usual dressings are applied to the neck.



Second phase—*This is performed after an interval of a minimum of six weeks*

Formation of the anterior wall of the skin hypopharynx

12 A longitudinal incision is made through the scar formed by the posterior skin wall of the hypopharynx and the lateral skin of the neck the inner portion is mobilized for a sufficient distance to form half the anterior wall of the hypopharynx. A similar longitudinal incision is made through the posterior skin wall of the hypopharynx on the opposite side and the inner portion is mobilized sufficiently to join with the free edge of the skin from the other side to form a skin tube. These incisions extend from the pharyngostomy to the oesophagostomy

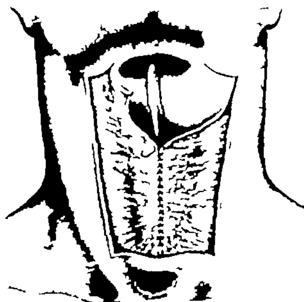


Suture and closure

13 The mucous membrane of the upper part of the pharyngostomy is separated from the skin of the submandibular region and is anastomosed to the two skin flaps with interrupted sutures of alternate fine nylon and catgut (No 0) The two skin flaps are joined in the mid-line of the neck by interrupted sutures of fine nylon placed 0·3 cm apart

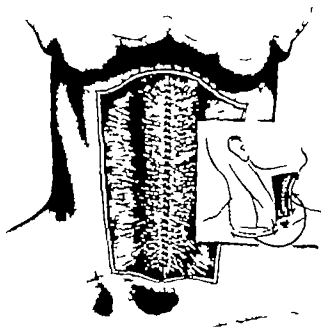
The two longitudinal incisions in the neck are continued medially through the skin bridge between the tracheostomy and oesophagostomy to meet.

The skin edges are sutured together with interrupted sutures of fine nylon placed 0 8 cm apart.



Provision of skin cover for the new hypopharynx and raw area of the neck

14 A whole thickness skin graft is rotated anteriorly from the postero-lateral aspect of the neck. It is widely based on the occipito-mastoid region. The width of the lower part of this flap is cut equal to the length of the new skin hypopharynx which extends from the submandibular region to the posterior border of the tracheostomy



Rotation of the skin graft

15 The antero-inferior corner of the skin graft is rotated and sutured to the antero-superior corner of the skin defect. The edges of the graft are sutured to the skin edges of the raw area in the neck and of the posterior aspect of the tracheostomy. The triangular raw area which is left postero-laterally is covered with a split-thickness skin graft taken from the thigh. Small lateral drainage tubes are inserted in the wounds to drain the region of the skin hypopharynx. A polythene tube with a small diameter is passed through the nose into the lower end of the oesophagus. A tube is placed in the tracheostomy and the posterior wall of this is protected from pressure by gauze. Dressings are applied to the neck.



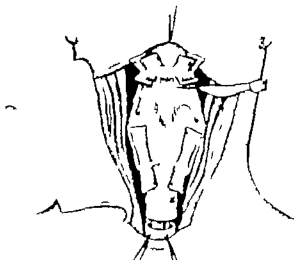
LARYNGO-PARTIAL PHARYNGECTOMY

The technique is the same as described for laryngo-pharyngectomy until the steps of mobilization are reached. After the superior and recurrent laryngeal nerves are divided there is no necessity to separate the posterior wall of the hypopharynx from the pre-vertebral fascia.

SUBSEQUENT STEPS

Division of the trachea and formation of the tracheostomy

16 The trachea is divided between the second and third, or third and fourth tracheal rings, depending upon the extent of the carcinoma. The lower end of the trachea is drawn forward and its anterior wall is sutured to the skin above the manubrium sterni by interrupted sutures of nylon of medium thickness. The rubber endotracheal tube is divided well above the tracheostomy so that the inflated cuff is left undisturbed and the anaesthetic is continued through the distal tube.



Removal of the larynx and part of the hypopharynx

17 The lower end of the trachea is held forwards and its posterior surface is separated by blunt dissection from the cervical oesophagus as far as the pharyngo-oesophageal junction

The hypopharynx is now opened through a transverse incision through the thyro-hyoid membrane or above the hyoid bone depending on the upper limit of the carcinoma.

The exact extent of the carcinoma is palpated and the resection of the larynx and part of the hypopharynx is carried out with the left index finger inserted in it so the incisions are made 2·5 cm. away from the edge of the growth. The longitudinal lateral or postero-lateral, incisions through the wall of the hypopharynx meet anteriorly at, or above, the pharyngo-oesophageal junction. After the larynx and part of the hypopharynx are removed a strip of the latter remains which is reconstructed.



Closure of the lateral compartment of the neck

One or both sternomastoid muscles are sutured to the prevertebral fascia with interrupted catgut sutures. A polythene tube of small diameter is passed through the nose into the lower end of the oesophagus for feeding.

Reconstruction of the hypopharynx

18 The strip of hypopharyngeal mucous membrane is now constructed into a tube by approximating the edges of the mucous membrane by a continuous suture of catgut (No 0) placed so that the edges are inverted. This line is reinforced by approximating the divided constrictor muscles by a continuous suture of catgut (No 0)



Closure of the wound

Two soft rubber drainage tubes are inserted on each side of the hypopharynx and brought out through the lower lateral angles of the wound. The posterior wall of the trachea is sutured to the lower edge of the quadrilateral skin flap and the remaining skin edges are sutured.

SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

CARCINOMA OF THE OROPHARYNX

Immediate post-operative care

At the end of the operation bronchoscopic aspiration is performed. At this stage anaesthesia should be very light and consciousness should be regained within 20 minutes The patient is then placed in a sitting position, provided the blood pressure is satisfactory and the head is prevented from rolling by small lateral pillows.

Subsequent treatment

For the initial 24 hours intravenous fluids are given until the possibility of post-operative vomiting has passed away Tube feeding is then begun. Normal feeding is resumed after two weeks provided the wounds have healed. Excessive secretion from the respiratory passages and coughing are diminished by giving small doses of belladonna or atropine. A suction pump is necessary for tracheal aspiration. Routine wound treatment is carried out. The lower drainage tube is removed after 48 *hours* and the upper one after 5 days. The tracheotomy tube is removed at the end of the first week. Primary healing of the wound without leakage of saliva is usually achieved.

CARCINOMA OF THE HYPOPHARYNX

LARYNGO-PHARYNGECTOMY AND LARYNGO-OESOPHAGO-PHARYNGECTOMY

Immediate post-operative care

At the end of the operation bronchoscopic aspiration is performed through the tracheostomy At this stage anaesthesia should be very light and consciousness should be regained within 20 minutes. The patient is placed in a sitting position, provided the blood-pressure is satisfactory and the head is prevented from rolling by small lateral pillows.

After the excisional operation

A suction pump is placed at the bedside to aspirate tracheal secretions at intervals the catheter is inserted into the trachea as far as the carina. Severe dyspnoea or tachycardia usually implies tracheal or bronchial obstruction by secretion, and is relieved by aspiration, if necessary using a bronchoscope. The patient is encouraged to cough. Nutrition is maintained by intravenous infusion for the initial 24 hours until the possibility of anaesthetic vomiting has gone tube feeding is then begun and the daily intake should be 3 000 calories with vitamins and iron. Chemotherapy is instituted for a period until the wounds have healed. Excessive secretion from the respiratory passages and coughing are diminished by giving small doses of belladonna or atropine. The neck is dressed after 48 hours and the drainage tube is removed the skin around the tracheostomy is protected by zinc cream and icthyol (equal parts) Gauze is also placed behind the tracheostomy to prevent saliva entering the trachea. Thyroid extract is given (0 5 gr daily) Everything is done to maintain the patient s morale

After the reconstructional operation

Tracheal suction is required as after the first operation belladonna or atropine is given. During the initial 24 hours nutrition is maintained by intravenous infusion and afterwards routine tube-feeding is carried out. The drainage tubes are removed after 10 days. The wounds heal after 2 or 3 weeks and the polythene tube can be removed and normal swallowing resumed. A metal shield is provided to cover the tracheostomy by day and the patient usually prefers to wear a tube at night. Speech therapy is given.

Special complications

Tetany

This is uncommon and may be mild. Calcium lactate is given in the feeds (30–60 gr 3 times daily) if this does not relieve the spasms parathormone is given.

Fistula formation

There are three chief varieties.

High submaxillary fistula.—An opening develops in the region of the posterior aspect of the tongue. It is repaired by reflecting a flap of mucous membrane from the posterior aspect of the tongue leaving its upper border attached to the tongue and suturing its lower border to the upper free margin of the skin hypopharynx. Skin cover is provided by an acromio-pectoral tubed pedicle graft.

Median fistula.—This develops in the mid-line about the middle of the neck. It is closed by freshening the edges of the fistula and closing the inner skin lining and outer skin cover separately in layers.

Low pharyngo-tracheal fistula.—This is usually caused by pressure of the tracheotomy tube on the posterior wall of the tracheostomy with ulceration into the skin hypopharynx and cervical oesophagus. To prevent this complication make the tracheostomy as far away as possible from the oesophagostomy with a bridge of skin between them. Avoid pressure of the tracheotomy tube against the posterior wall of the tracheostomy by gauze protection. When the fistula is small spontaneous healing may occur. If not it may be possible to freshen its edges and suture them but only when this can be done without tension or a bigger fistula will result. A more intricate plastic operation is required to close a large fistula and it may be best to treat it conservatively. Patients can swallow if a tracheotomy tube is fitted so that its posterior wall forms an efficient anterior wall for the fistula, a small piece of tulle gras placed over the fistula behind the tube.

LARYNGO-PARTIAL PHARYNGECTOMY

A suction pump is placed at the bedside to aspirate tracheal secretions at intervals. Severe dyspnoea or tachycardia is usually caused by tracheal or bronchial obstruction and is relieved by aspiration, if necessary through a bronchoscope. Nutrition is maintained by intravenous infusion for the initial 24 hours, after this tube feeding is commenced. Excessive secretion from the respiratory passages is diminished by small doses of belladonna or atropine. The patient is encouraged to cough. Routine treatment for the wound is given and the drainage tubes are removed at the end of the first week. The oesophageal tube is removed at the end of the second week if the wound has healed and normal feeding is resumed. Voice production by a speech therapist is commenced. A metal shield to cover the tracheostomy by day is provided, the patient may prefer to wear a tracheotomy tube at night.

[*The illustrations for this Chapter on Carcinoma of the Pharynx were drawn by Miss June Alaster and Mr Peter Cull.*]

Bibliography

Raven, R. W (1952). *Brit. J Surg.*, **39**, 603
— (1952). *Brit. med. J.*, **1**, 951
— (1953). *Proc. R. Soc. Med.*, **46**, 770.
— (1954) *Brit. J Surg.*, **42**, 118.
— (1955). *Ann. d'Oto-Laryngol.*, **72**, No 7 495.
Trotter W (1932). *Brit. med. J.*, **1**, 510
Wookey H. (1948). *Brit. J Surg.*, **35**, 249

BLOCK DISSECTION OF CERVICAL LYMPH NODES

M R. Ewing, M B Ch B F R C S
Professor of Surgery University of Melbourne

PRE-OPERATIVE

Indications

The operation is indicated in the control of metastatic cervical cancer The primary tumour is most often in the mouth but it may also be in the throat, nose thyroid, salivary gland or in that area of skin the lymph drainage of which is to the cervical nodes. Block dissection can sometimes conveniently be combined with excision of the primary in continuity as an *en bloc* operation. Practice varies but in many clinics it is the custom to excise the nodes only when there is clinical evidence of their enlargement.

The operation is in no sense a dissection of individual lymph nodes it is designed to remove in a single mass all the lymph nodes which lie in the anterior and posterior triangles of the neck as well as their associated lymph channels.

Special contra-indications

The operation is justified only if there is reasonable expectation of controlling the tumour at the primary site. It is often more logical to attempt to treat cervical node metastases by radiotherapy where, for example the primary is inaccessible and radiosensitive, especially if there are in addition bilateral metastases.

The operation can be done on both sides. There is no need to preserve either jugular vein, but separation of the two operations by as many weeks as is safely possible lessens the risk of distressing venous congestion of the head.

Special equipment or apparatus

Good illumination and a sucker are essential. A generous supply of Dunhill s curved artery forceps is also advisable, as well as two small strong hook retractors.

Pre-operative preparation

The hair should be shaved above and behind the ear and on the neck as far as the nape posteriorly

Anaesthesia

There is no satisfactory alternative to general anaesthesia given through a cuffed endotracheal tube a free airway throughout is essential.

Position of patient

The shoulders are supported by a flat pillow The head is first covered by the top layer of a double head towel, secured on the forehead. Four towels are now disposed, two transversely and two longitudinally so as to give access to the side of the neck from the lower part of the cheek and the chin above to the level of the first rib below and from trapezius laterally to just beyond the midline on the opposite side. The towels can conveniently be secured by suturing them to the skin.

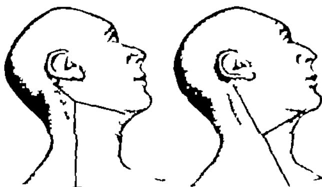
The table is inclined so that the patient is in a slight foot-down position.



THE OPERATION

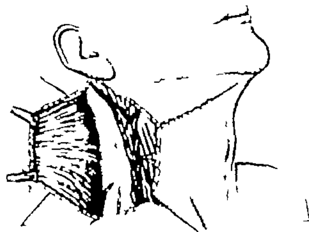
The incision

1 There are several alternatives. All are designed to lay open the neck from the mandible above to the clavicle below and from the anterior margin of trapezius laterally to the midline in front. The one illustrated is that used by Hayes Martin in the Memorial Hospital in New York. Each flap is fashioned on a wide base. The limbs of the incisions diverge at angles of 120 degrees with each other. The upper and posterior limb begins on the mastoid process.



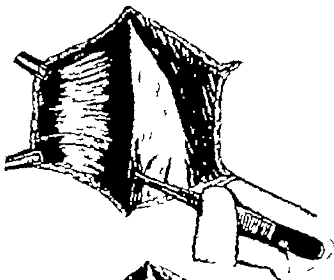
Alternative incisions

2 The incisions illustrated are alternatives to the one shown above. Neither gives such a wide exposure.



Reflection of posterior skin flap

3 The posterior skin flap is dissected back to expose the sternomastoid muscle and the external jugular vein crossing the cutaneous branches of the cervical plexus. (We retain platysma in the skin flaps but it is common practice to make them only skin thick.)



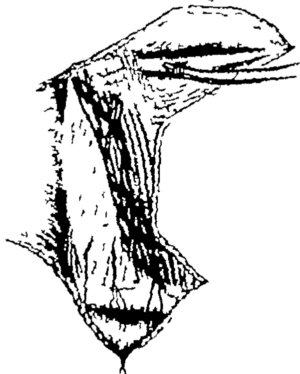
Identification of the anterior margin of trapezius

4 This marks the posterior limit of the dissection The muscle is most readily identified below its anterior margin can then be followed upwards.



Reflection of lower flap

5 The lower flap is turned down beyond the clavicle and secured to the skin of the chest wall by a stitch.



Reflection of upper flap

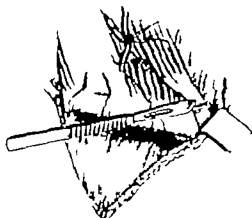
6 The upper flap is turned upwards to immediately above the lower margin of the mandible the lower pole of the parotid will also be seen It may be possible to preserve the mandibular branch of the facial nerve as it turns forwards on the deep aspect of the flap The facial vessels are dissected out and divided between ligatures immediately below the lower margin of the mandible.



Completion of exposure

7 The anterior flap is now turned forwards to a point just beyond the midline The submandibular region is thereby laid open along with the hyoid bone and the insertion of the infra-hyoid muscles.

The submental triangle is laid open by continuing the dissection as far as the anterior belly of the digastric muscle on the opposite side of the neck.



Division of origin of sterno-cleido-mastoid muscle

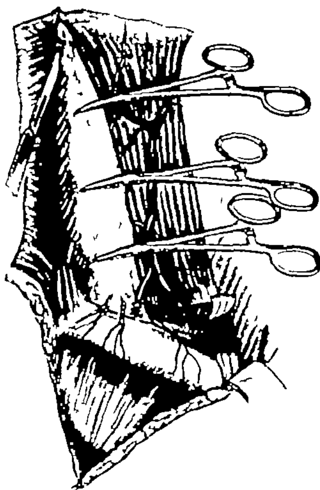
The sternal head

8 The rounded tendinous sternal head is readily divided close to its origin.



The clavicular head

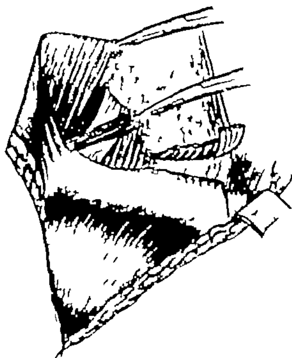
9 The flat clavicular head is divided with some care. It can be cautiously divided with a scalpel, efforts being made at the same time to catch several small but troublesome vessels before their division. Alternatively a blunt elevator can be inserted with care under the muscle, which is then divided with scissors.



Commencement of block dissection

10 An incision is made through the fascia along the anterior margin of trapezius and on the clavicle Above, the occipital artery or its branches may be difficult to find and control. Lower down the accessory nerve will be cut as well as muscular branches from the cervical plexus The external jugular vein is divided just above its termination in the subclavian.

All major veins in the root of the neck must be secured with considerable care The risk of air embolism is a very real one.



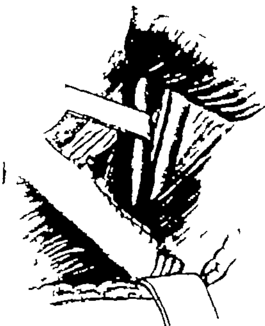
Identification of omohyoid muscle

11 The fat and fascia are seized by artery forceps and drawn forwards to display the muscles which form the floor of the posterior triangle. The narrow strap of muscle running upwards and medially just above the clavicle is the inferior belly of omohyoid.



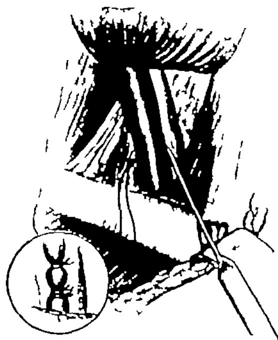
Division of omohyoid muscle

12 The inferior belly of the omohyoid muscle is divided where it dips deep to trapezius. From here it is followed forwards in the loose fibro-fatty tissue which forms an investment for the brachial plexus. The muscle forms an excellent guide to the position of the plexus.



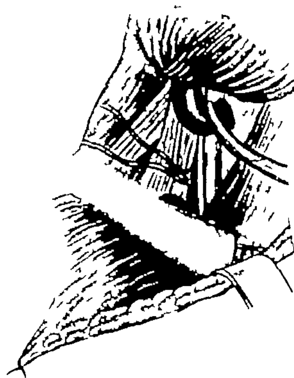
Exposure of internal jugular vein

13 The internal jugular vein is now exposed by blunt dissection in the root of the neck. It can usually be readily identified as a blue structure seen through the investing fascia. The vagus nerve is more intimately related to the common carotid artery than to the vein it must, however be identified before division of the vein.



Division of the internal jugular vein

14 The internal jugular vein is divided between ligatures. Care should be taken not to injure an occasional tributary on its posterior aspect. If the vein is torn at this stage the risk of air embolism is considerable



Upward dissection of the "block"

15 The sternomastoid and omohyoid muscles and the internal jugular vein are now turned upwards and are readily separated by gauze dissection from the carotid artery and the vagus nerve. The phrenic nerve is seen crossing the scalenus anterior It may be necessary to tie the suprascapular and transverse cervical arteries. The thoracic duct may be seen when the dissection is on the left side. Any leak of lymph should be controlled by a carefully applied fine silk ligature.

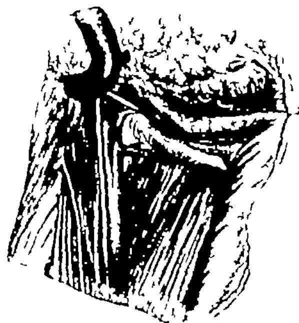
The omohyoid muscle is separated off from the adjoining strap muscles and followed forward to its insertion on the hyoid bone where it is divided.

The superior thyroid vein is divided between ligatures the artery need not be sacrificed.



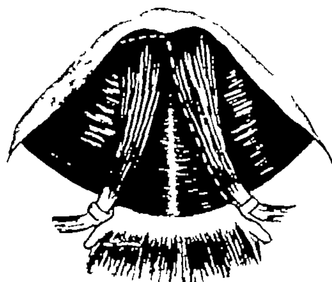
Division of fourth cervical nerve

16 The phrenic nerve must be followed upwards, care being taken not to include it in the forceps when controlling haemorrhage from nearby vessels which may be torn during the dissection The fourth cervical nerve is divided distal to the origin of the main root of the phrenic nerve.



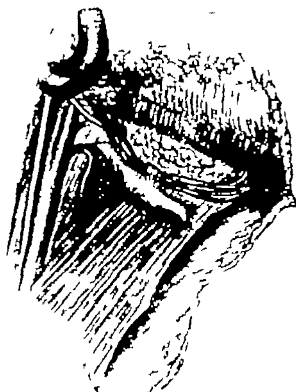
Identification of the hypoglossal nerve

17 As the block" is turned upwards the third cervical nerve will be cut across in line with the fourth. Several tributaries entering the anterior aspect of the internal jugular vein must be secured. The hypoglossal nerve which is not yet readily accessible will be found running forwards across the carotid vessels just below the posterior belly of the digastric muscle.



Dissection of submental region

18 The submental region is cleared by an incision through the fascia along the medial margin of the anterior belly of the digastric on the opposite side. The fascia and nodes are cleared from the mylohyoid and the anterior belly of digastric is divided at its insertion.



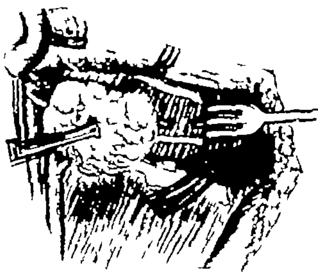
Mobilization of the submandibular salivary gland

19 The fascia is divided along the lower margin of the mandible so that the submandibular salivary gland can be delivered into the wound.



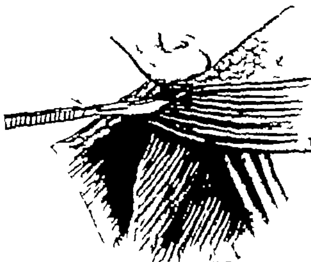
Division of lower pole of the parotid

20 The lower pole of the parotid is cut across, and the posterior facial vein secured.



Dissection of submandibular region

21 A retractor under the edge of mylohyoid gives access to the deep anterior extension of the gland and its duct which is divided. Care must be taken to avoid the large flat lingual nerve above and the hypoglossal nerve below both on the hyoglossus muscle



Division of insertion of sternomastoid muscle

22 The sternomastoid muscle is divided at its insertion into bone.

23 Division of spinal accessory nerve

During the division of the sternomastoid the accessory nerve will be found superficial (usually) to the internal jugular vein and so distorted by the dissection that it is seen passing forward into the muscle.

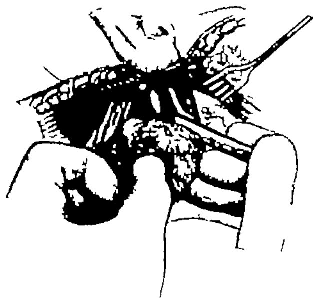
Any attempt to preserve the accessory nerve inevitably compromises the completeness of the operation for there is an important chain of lymph nodes which lies in the closest relation to the nerve as it runs across the posterior triangle.



24 Division of upper end of jugular vein

The posterior belly of digastric is retracted upwards (or it may be removed along with the stylohyoid muscle) and the internal jugular vein is identified and tied between ligatures close up to the base of the skull.

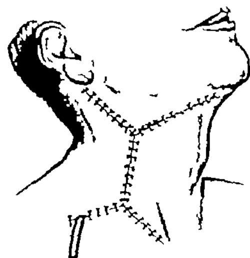
Some tributaries from the pharyngeal plexus, which enter the vein on its deep aspect, often cause trouble One of the advantages of dividing the vein first below and then above is that, at this stage in the dissection, the distended vein is readily identifiable.





The completed dissection

25 In this case the posterior belly of the digastric muscle was not removed.
The carotid vessel and its branches and the vagus nerve lie freely exposed. Posteriorly are the divided cervical nerve roots, the phrenic nerve and the brachial plexus. Anteriorly the hypoglossal nerve can be seen crossing the empty submandibular triangle.



Closure of wound

26 The wound is closed, one or more rubber tissue drains being brought out through the lower end of the wound. A firm occlusive dressing is applied.

SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Reactionary haemorrhage

Care must be taken to establish complete haemostasis before closure Bleeding can almost always be controlled by pressure alone.

Fluid collection under skin flaps

Every effort must be made to prevent this by carefully applied pressure dressings, adequate drainage and needling as required.

Lymph fistula

This will almost invariably close spontaneously

Gangrene of skin flaps

This will delay complete healing Grafting is seldom required.

Paralysis of the depressor of the lower lip

This is a common complication, due to damage to the mandibular branch of the facial nerve. It is not disabling and considerable recovery is almost the rule.

Other nerve palsies

It is easy to damage the phrenic nerve or one of its roots. It is likely that temporary paralysis often passes unnoticed clinically

Horner s syndrome is often noticed in the first few days after operation, but it is seldom lasting

[*The illustrations for this Chapter on Block Dissection of Cervical Lymph Nodes were drawn by Miss Jill Payne*]

Bibliography

Ewing, M. R., and Martin, H. (1952) *Cancer* 5 873.
Martin, H., Del Valle, B Ehrlich, H., and Cahan, W G (1951). *Cancer* 4, 441

EXCISION OF AXILLARY AND INGUINAL LYMPH NODES

R. W Nevin, T D M B F R C S

Surgeon St Thomas's Hospital London

PRE-OPERATIVE

Indications and contra-indications

One or two glands may be removed as a local and minor procedure for microscopical examination. An about 2 inches long in the skin creases may be used for this.

In malignant disease provided that there is no local fixation to important structures and no more dista stasis, the clinical involvement of one or more nodes in the axillary or inguinal group should be treated by c of the area of its lymphatic glands and vessels—a radical block dissection. These are the procedures which described in detail

Surgery gives much better results than radiation which should be reserved for the inoperable or recurre Prophylactic block dissection is not recommended. These patients should be examined carefully at regular and should the clinical signs of involvement appear block dissection is carried out at once

In the case of the reticuloses, after the diagnosis has been established by biopsy treatment is by radiothera

A full course of antibiotic treatment should be given for tuberculosis and other chronic infections. involvement of glands remains—with or without sinus formation—a modified dissection should be carried

Extent of operation

A radical block dissection of lymphatic tissue aims at removing both vessels and glands in one shee inguinal region the operation is not complete unless the external iliac group of lymphatic glands are r These glands and the deep group of inguinal glands form a continuous chain The extension of the o upwards to remove the external iliac lymphatic glands necessitates the division of the inguinal ligame suturing of this ligament requires great care. Up to the present time we have not observed any post-o weakness in the inguinal region following this procedure.

Anaesthesia

General anaesthesia should be used.

Position of patient

Excision of axillary glands —The head is resting on a low pillow and is inclined to the opposite side Th abducted to a right angle and externally rotated the elbow is flexed to 90 degrees and the wrist fixed to the the table by means of a bandage tied at the wrist with a clove hitch.

The skin is prepared and a large pad of sterile absorbent wool is placed behind the posterior axillary fold ar the abducted arm.

Sterile towels are placed first longitudinally—one towel 1 inch to the near side of the mid-line and the the line of the posterior axillary fold. Towels are placed transversely at the level of the clavicle and the upp

Excision of inguinal glands —The patient lies supine on the operating table with the thighs slightly abducte The skin is prepared and the groin and the upper third of the thigh are towelled off

SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Reactionary haemorrhage

Care must be taken to establish complete haemostasis before closure. Bleeding can almost always be controlled by pressure alone.

Fluid collection under skin flaps

Every effort must be made to prevent this by carefully applied pressure dressings, adequate drainage and needling as required.

Lymph fistula

This will almost invariably close spontaneously

Gangrene of skin flaps

This will delay complete healing Grafting is seldom required.

Paralysis of the depressor of the lower lip

This is a common complication, due to damage to the mandibular branch of the facial nerve. It is not disabling and considerable recovery is almost the rule.

Other nerve palsies

It is easy to damage the phrenic nerve or one of its roots. It is likely that temporary paralysis often passes unnoticed clinically

Horner s syndrome is often noticed in the first few days after operation, but it is seldom lasting

[The illustrations for this Chapter on Block Dissection of Cervical Lymph Nodes were drawn by Miss Jill Payne]

Bibliography

Ewing, M. R., and Martin, H. (1952) *Cancer* **5** 873.
Martin, H., Del Valle, B., Ehrlich, H., and Cahan, W G (1951). *Cancer* **4**, 441

EXCISION OF AXILLARY AND INGUINAL LYMPH NODES

R. W. NEVIN T D M B F R C S

Surgeon St Thomas s Hospital London

PRE-OPERATIVE

Indications and contra-indications

One or two glands may be removed as a local and minor procedure for microscopical examination An incision about 2 inches long in the skin creases may be used for this.

In malignant disease provided that there is no local fixation to important structures and no more distant metastasis, the clinical involvement of one or more nodes in the axillary or inguinal group should be treated by clearance of the area of its lymphatic glands and vessels—a radical block dissection. These are the procedures which will be described in detail

Surgery gives much better results than radiation which should be reserved for the inoperable or recurrent cases. Prophylactic block dissection is not recommended. These patients should be examined carefully at regular intervals and should the clinical signs of involvement appear block dissection is carried out at once

In the case of the reticuloses, after the diagnosis has been established by biopsy treatment is by radiotherapy

A full course of antibiotic treatment should be given for tuberculosis and other chronic infections. If active involvement of glands remains—with or without sinus formation—a modified dissection should be carried out.

Extent of operation

A radical block dissection of lymphatic tissue aims at removing both vessels and glands in one sheet. In the inguinal region the operation is not complete unless the external iliac group of lymphatic glands are removed. These glands and the deep group of inguinal glands form a continuous chain The extension of the operation upwards to remove the external iliac lymphatic glands necessitates the division of the inguinal ligament. The suturing of this ligament requires great care Up to the present time we have not observed any post-operative weakness in the inguinal region following this procedure

Anaesthesia

General anaesthesia should be used.

Position of patient

Excision of axillary glands.—The head is resting on a low pillow and is inclined to the opposite side The arm is abducted to a right angle and externally rotated the elbow is flexed to 90 degrees and the wrist fixed to the head of the table by means of a bandage tied at the wrist with a clove hitch.

The skin is prepared and a large pad of sterile absorbent wool is placed behind the posterior axillary fold and under the abducted arm

Sterile towels are placed first longitudinally—one towel 1 inch to the near side of the mid line and the other in the line of the posterior axillary fold Towels are placed transversely at the level of the clavicle and the nipple

Excision of inguinal glands.—The patient lies supine on the operating table with the thighs slightly abducted.

The skin is prepared and the groin and the upper third of the thigh are towelled off.

THE OPERATIONS

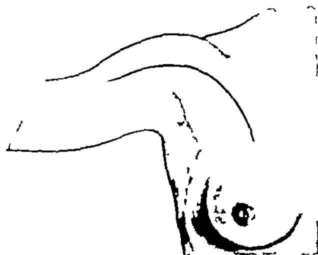
AXILLARY GLANDS

The incision

1 The incision is curved and is placed high above and medial to the anterior axillary fold it commences about 1 inch below and distal to the acromio-clavicular joint and is about 7 inches long

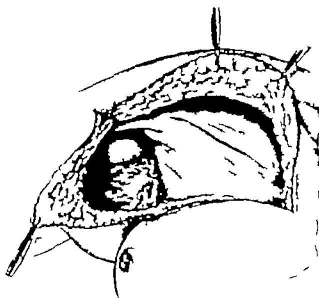
The radical block dissection of the axilla involves the removal or division of muscles in order to expose the upper two-thirds of the axilla and ensure the complete removal of the lymphatic vessels and nodes.

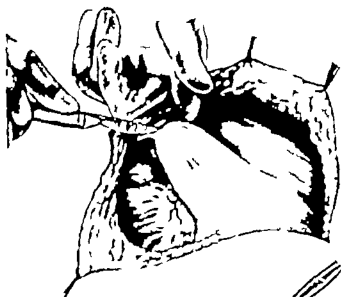
Tuberculous and other inflammatory glands may be removed satisfactorily by retracting the pectorals and not removing them.



Skin flaps

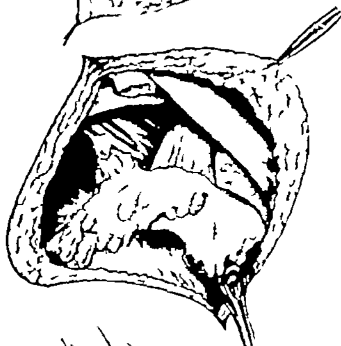
2 Flaps are dissected upwards and medially and downwards and laterally to expose the pectoralis major and the outer part of the axillary contents. The lower flap is dissected down until the posterior axillary fold is defined.





3
Definition and division of sternal head of pectoralis major

The fascia is cleared from the surface of the pectoralis major and the interval between the clavicular and sternal portions of the muscle defined. A finger is inserted into this interval and the tendon of the sternal portion lifted up and divided.



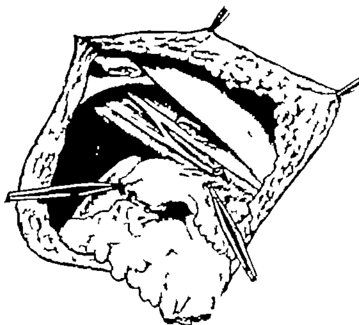
4
Reflection of sternal head of pectoralis major

The sternal head of pectoralis major is reflected together with the axillary fat and contained lymphatic glands exposing the underlying neuro-vascular bundle, the pectoralis minor and costo-coracoid membrane.



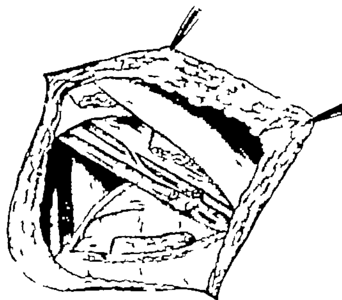
5
Division of pectoralis minor

The pectoralis minor is divided as near to the coracoid process as possible and the costo-coracoid membrane is divided from the first rib



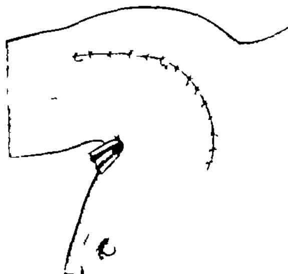
Reflection of pectoralis minor

6 The pectoralis minor is reflected and the lateral thoracic artery and corresponding veins are divided and ligated. The medial anterior thoracic nerve is divided.



Completion of axillary dissection

7 The axillary fat and contained glands and lymphatic vessels are dissected free from the subscapular vessels and the long subscapular nerve. The long thoracic nerve of Bell is identified and preserved All the fat is removed from the angle between these two nerves. The pectoralis major and minor are divided at the lower limit of the incision.



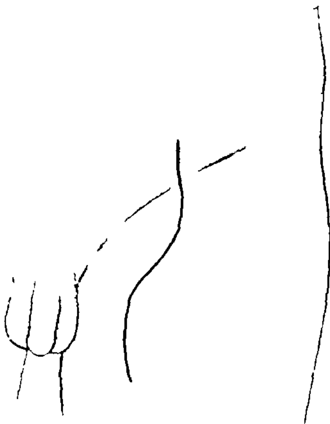
Closure and drainage

8 A counter-incision is made for drainage just in front of the posterior axillary fold and a corrugated rubber drain is inserted. The skin is sutured with interrupted sutures. It is not possible to approximate the deeper structures.

INGUINAL LYMPH NODES

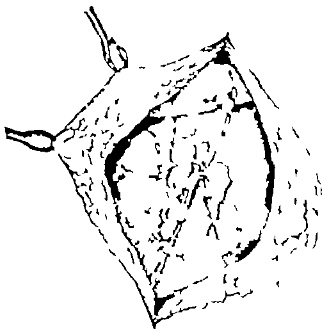
The incision

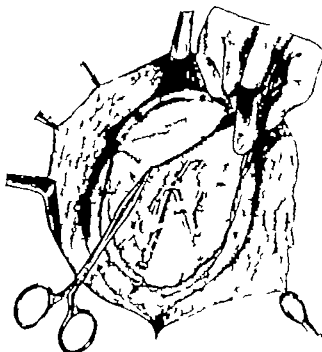
9 The incision commences 2 inches above the inguinal ligament and crosses it at a point midway between the anterior superior iliac spine and the symphysis pubis. It has a double curve first convex to the lateral side and then to the medial side It extends for about 5 inches below the inguinal ligament and reaches a point ½ inch below the apex of Scarpa's triangle Some surgeons (Lee 1956) prefer a long curved lateral incision just medial to the anterior superior iliac spine when one large skin flap is raised and turned inwards.



Skin flaps

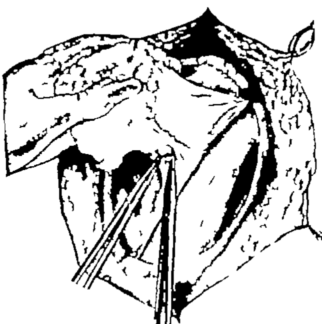
10 These consist of skin and a very small amount of fat and are raised medially and laterally for the whole extent of the inguinal ligament.
These flaps are thin and extensive, which accounts for frequent sloughing and infection of the skin edges.





Ligation of superficial veins and division of fascia

11 The internal saphenous vein and its tributaries are ligated as they enter the periphery of the field of operation. Scarpa's fascia is divided at the upper limit of the field and dissected down as a flap to the level of the inguinal ligament. The deep fascia of the thigh is similarly divided along the limits of exposure below the inguinal ligament.



Raising of the flap of deep fascia and ligation of the internal saphenous vein

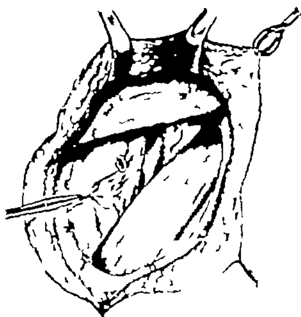
12 The flap of deep fascia is dissected up from below and the internal saphenous vein is identified on its deep surface as it enters the common femoral vein. It is picked up and divided between two pairs of artery forceps.

These flaps are designed to contain all the superficial lymphatic vessels and glands of the inguinal region both the horizontal and vertical groups.



Exposure of the deep vessels

13 The internal saphenous vein is ligated and the fascial flap is dissected up as far as the inguinal ligament. The deep vessels and the femoral canal with their associated fascia and lymphatic glands are exposed. The fascial flap is finally removed.

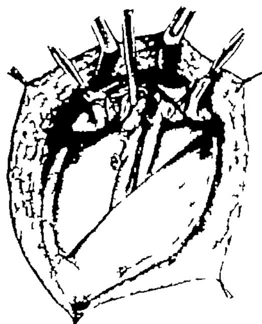


Excision of the deep inguinal lymph nodes

14 The fascia surrounding the vessels and the fascia forming the femoral canal are excised together with the contained lymphatic vessels and glands.

Exposure of the external iliac lymph nodes

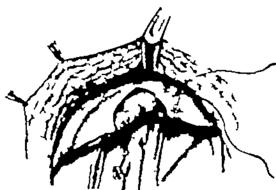
15 The inguinal ligament is divided where it crosses the vessels and the incision is carried up through the anterior wall of the inguinal canal The deep epigastric and the deep circumflex iliac arteries and veins are divided between ligatures. The divided inguinal ligament is held to either side with forceps The spermatic cord is retracted upwards and medially and the external iliac vessels and their associated lymphatic vessels and glands and fascia are thus exposed.



Removal of external iliac lymph nodes

16 The fascia surrounding the vessels is excised together with the lymphatic vessels and glands contained in it.

A chromic catgut stitch is inserted to suture the inguinal ligament.



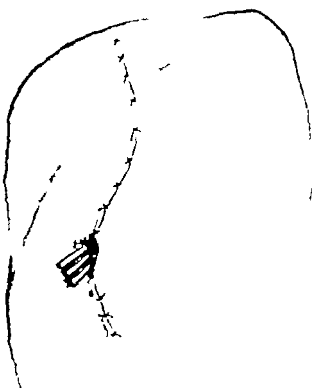
Suture of the inguinal ligament

17 The inguinal ligament and the external oblique muscle are sutured with interrupted chromic catgut stitches. Great care is required to approximate these tissues accurately



Closure of the wound

18 The wound is closed with interrupted stitches and a corrugated drain
An ample pad of gauze and supporting dressing should be firmly applied



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

AXILLARY GLANDS

Drainage of lymph from the wound is to be expected. Ample padding and a firm dressing are necessary. The drain should be shortened after 2 days and finally removed about the fifth day. A polythene tube and electric suction motor may be preferred as an alternative method of controlling drainage. Support to the arm and early physiotherapy will lessen the likelihood of oedema of the limb

INGUINAL LYMPH NODES

These wounds hardly ever heal *per primam*. There is much discharge of lymph. Infection is very common and sloughing of the wound edges is often seen. Careful skin preparation, the use of antibiotics and a firm supporting dressing will minimize these complications.

The drain should be shortened after the second day and finally removed about the fifth day; a polythene tube and continuous suction may be preferred as a method of drainage.

These wounds rarely require grafting when sloughing has occurred, although final healing may be delayed for some weeks.

Oedema of the leg should be treated by physiotherapy and a supporting stocking, when necessary

Bibliography

Estrade, J (1948). "L evidement inguinal pour adenopathies cancereuses." *Bull. Ass. franç. Cancer* **35**, 28.
Lee, E. S (1955). *Lancet*, **2**, 520
Spear B C. (1953) "Axillary Gland Dissection with Preservation of Pectoral Muscles for Glands of Upper Extremity " *Surgery* **34**, 701
Winslow Smith, J (1955). "Radical Axillary Dissection without Mastectomy " *Surg. Gynaec. Obstet. Brit Emp.*, **100**, 245

EXCISION OF THE MAXILLA
INCLUDING PALATAL FENESTRATION

JOHN F SIMPSON F R C S

Surgeon Ear Nose and Throat Department, St Mary s Hospital London

PRE-OPERATIVE

Indications

Radio-resistant neoplasms of the upper jaw demand excision of the maxilla.

Radio-sensitive malignant growths are usually treated by radiotherapy supplemented either by a p
attack upon the tumour employing morcellement removal and coagulation diathermy or followed by a
fenestration operation to facilitate post-irradiational observation. Incomplete disappearance of the grow
recurrence after radiotherapy requires excision of the jaw

Squamous-cell carcinoma of the antrum is the commonest tumour of the maxilla. The anaplastic form is
given radiotherapy in the first instance and generally the keratinizing form is similarly treated though
radical excision is open to choice in the latter form.

Adenocarcinoma (derived from the glands of the mucosa or from aberrant salivary tissue) and adamantin
next in frequency These, especially the adamantinoma, are relatively radio-resistant.

Bone sarcomas, including the differentiated forms such as fibrosarcoma and osteoclastoma, may be irradia
choice here between surgery and radiotherapy is not clearly defined.

Occasionally the reduction of an enlarged and distorted maxilla due to fibro-osseous dysplasia is nec
cosmetic purposes. A large osteoma may require a partial removal of the jaw

Contra-indications

Invasion of the base of the skull renders surgery ineffective. Extension into the soft palate and lateral p
carries a poor prognosis even when operation is supplemented by irradiation.

Special equipment

Bone forceps should include heavy shears, nibbling forceps—both straight and side biting—and Luc s forc
not bone holding forceps (lion type) which tend to crumble the jaw A Gigli saw and a half inch chisel are n

Fixation apparatus consisting of adjustable rods attached to a plaster cap is used for supporting the m
prosthesis which carries the skin graft.

Pre-operative preparation

Preparation of the prosthesis —For cases of total excision this consists of a palatal portion (similar to an uppe
plate) to which is added an extension representing the antero-external wall and inferior orbital rim of the r
Acrylic casts of a superior maxilla have been adapted and used for this purpose. Loops to receive the fixation
the nose are provided or a support via the mouth is incorporated in the palatal portion of the prosthesis.

A posterior extension to close the nasopharyngeal opening is required if the soft palate has to be removed.

Teeth, other than those in the maxilla to be excised, are extracted as may be necessary to eliminate sepsis.

Systemic disinfection is initiated by penicillin therapy the day before operation.

Anaesthesia and position of patient

Inhalation anaesthesia, using an endotracheal tube fitted with an inflatable cuff and pilot bag passed via the
is required alternatively a *nasotracheal tube may be passed through the contralateral nasal chamber* A gau
lightly packed in the pharynx gives further protection.

THE OPERATIONS

Types of resection

1 Results of excision of the maxilla are best when the neoplasm is confined within the bony cavity of the maxillary sinus or when limited to the antero-inferior part of the jaw in which case the orbital floor may be spared

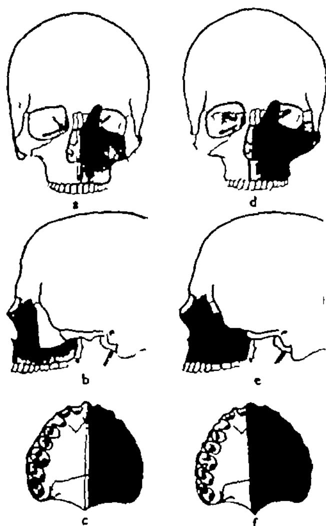
The ethmoidal labyrinth should always be removed in the case of the larger growths as it may be invaded or even may have been the primary site of the neoplasm The floor of the frontal sinus and anterior face of the sphenoidal sinus are usually removed to promote the drainage of a coexisting chronic infection in these sinuses as well as to provide thorough extirpation.

The excision may have to be extended to include adjacent structures such as the overlying soft tissues of the face, the orbital contents, the soft palate, the nasal septum with the floor of the opposite side of the nose and perhaps a portion of the opposite maxilla.

Owing to the late appearance of the cervical lymphatic metastases in carcinoma of the antrum a block dissection of the neck is not often combined with the excision.

Excision may be carried out either via a facial flap or sublabial incision.

The lines of bone section are determined by the size and position of the neoplasm and the operations are accordingly classified as (1) formal (*a b* and *c*) (2) extended (*d e* and *f*) and (3) partial.



FORMAL EXCISION

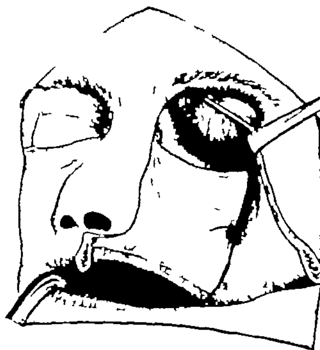
The facial incision

2 The incision starts by curving round the inner margin of the orbit from below the inner end of the eyebrow It then passes down the side of the nose to turn inwards below the nostril so entering the nasal vestibule deeply and then descends vertically to divide the lip in the midline. To permit accurate repositioning the upper limit of the red margin of the lip is exactly marked by a needle scratch.



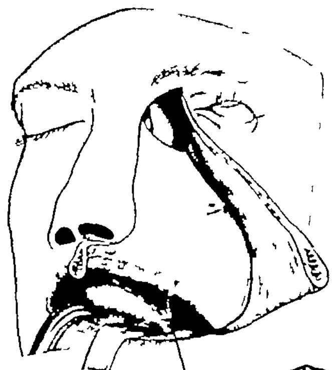
Completion of facial incision

The facial flap is completed by an incision in the gingivolabial sulcus starting in the midline and extending backwards to sweep behind the tuberosity of the maxilla.
Additional incisions below the lower lid and in the inferior conjunctival fornix are not necessary in the formal excision.



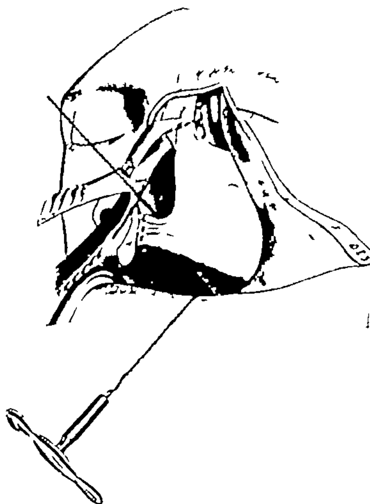
Reflection of the flap

3 The soft tissues of the face forming the flap are raised by the diathermy knife or scalpel and rugine.
At the orbital margin separation is carried into the orbit deep to the periorbital fascia (periosteum)
The tear duct is severed and the bony floor inner wall and inner part of the roof of the orbit are exposed.
Posterolaterally the tuberosity and posterior aspect of maxilla are cleared. Above this the flap is raised from the outer surface of the malar bone and the outer part of the floor of the orbit is exposed.



Detachment of the soft palate

4 A transverse incision from the midline with a diathermy knife detaches the soft palate from the hard palate on the affected side.
Laterally the incision passes behind the tuberosity to join the sublabial incision.

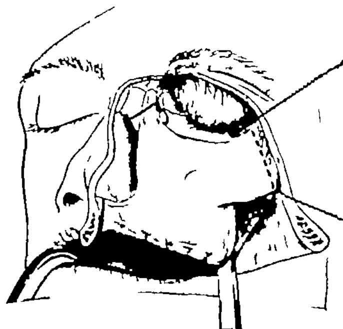


Division of the superior and inferior bony attachments

5 Shears divide the nasal bone and ascending process of the maxilla

A Gigli saw passed through the incision between hard and soft palate cuts the floor of the nose from behind forwards close and parallel to the inferior attachment of the septum.

The saw cut passes through the upper alveolus anteriorly



Division of the lateral and posterior bony attachments

6 The Gigli saw is introduced downwards through the outer extremity of the inferior orbital fissure which has been exposed in the orbital floor The saw emerges from the temporal fossa below the anterior root of the zygomatic arch which is then divided.

The posterior attachment to the pterygoid process is detached by driving a chisel upwards and slightly inwards at a point immediately behind the tuberosity of the maxilla.

Detachment of the maxilla

7 The only remaining attachment of the maxilla to the skull is by the frail ethmoidal labyrinth and lachrymal bone. When held by the finger and thumb the maxilla can be rocked and separated. Any strands of soft tissue still holding are cut across.

Haemorrhage from the internal maxillary artery or its branches is controlled by pressure packs and diathermy coagulation.

When severe haemorrhage is anticipated the external carotid artery can be ligated in the neck as the first step in the operation, but this is not usually necessary

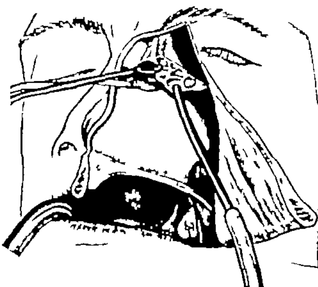


Trimming and enlarging the cavity

8 The remains of the ethmoidal labyrinth are demolished by using Luc's forceps and the sucker nozzle. The floor of the frontal sinus is removed by means of side biting punch forceps.

If the neoplasm has been accompanied by a pansinusitis the anterior wall of the sphenoidal sinus should be nibbled down by Hajek's or other form of small punch forceps.

Any redundant or doubtful tissue is coagulated or removed, including the infraorbital nerve which may have been pulled out of the maxilla.

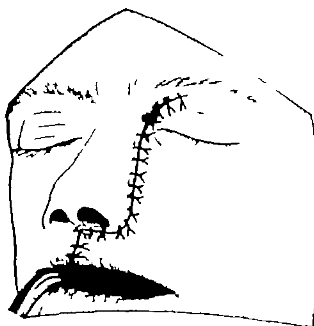




Skin grafting the cavity

9 A large Thiersch graft is cut and laid on the previously prepared prosthesis so that it comes into contact with the periorbital fascia and raw deep surface of the facial flap

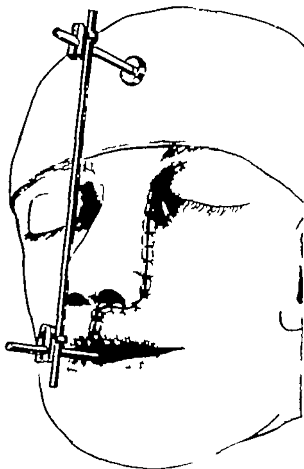
If such a prepared prosthesis is not available a plastic sponge cut roughly to conform to the cavity may be used instead. The buccal aspect of the sponge is covered by a dental plate if the patient has worn one.



Closure of the incision

10 Closure of the facial incision is by interrupted sutures starting at the scratch mark on the red margin of the lip which ensures accurate apposition.

The incision on the deep aspect of the lip is closed up to the gingivolabial sulcus.

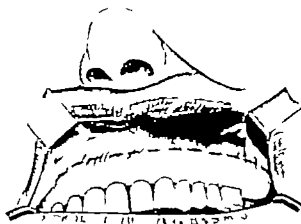


Fixation of the prosthesis

11 Fixation rods are angulated and connected to enable the prosthesis to be supported from a plaster skull cap

The palatal portion of the prosthesis receives a rod passed through the mouth or nostril.

In this way the eyeball is supported and the skin graft kept in close contact with the raw areas to be epithelialized, so minimizing contraction by fibrosis which tends to lower the level of the eye.



Alternative incisions

The sublabial incision

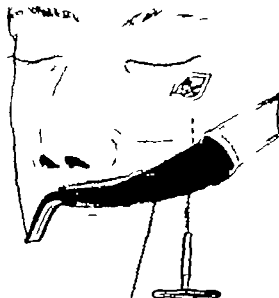
12 This long incision avoids a facial scar and when retracted provides adequate access so that it is often preferred.

The incision starts in the gingivolabial sulcus in the contralateral canine fossa and ends behind the tuberosity of the maxilla.

Supplementary incisions to divide the lateral bony attachment of the maxilla

13 *Orbital stab incision*—A downwardly directed stab incision to the floor of the orbit is made to enter the outer extremity of the inferior orbital fissure

One end of the Gigli saw is passed through the fissure to emerge deep to the zygomatic arch whilst the other end is passed via the same incision deep to the facial tissues but superficial to the orbital rim This facilitates division of the lateral bony attachment should access be difficult, especially with the sublabial approach.



14 *Curved incision*—A small curved incision is made over the angle formed by the posterior border of the vertical process and the upper border of the horizontal process of the malar bone. This allows the introduction of shears to divide the former process horizontally and the latter vertically when a more extended excision of the malar region is desired.





EXTENDED OPERATIONS

Removal of infiltrated facial soft tissues with the maxilla

15 The infiltrated tissues are amply circumvented by an incision made with a diathermy knife. The incision is made to loop from the formal facial incision.

Removal of orbital contents with the maxilla

16 When the orbital contents require removal the case is such that it is usually necessary to remove the cheek also

To achieve this the upper end of the facial incision already described is carried outwards to cross the upper lid. It then sweeps downwards along the outer margin of the orbit, over the malar prominence and then curves inwards to join the facial incision in the nasofacial sulcus.

The skin of the upper eyelid is reflected off the tarsal plate and the dissection is continued to separate the periosteum (periorbital fascia) from the roof, inner and outer walls of the orbit. This is continued until the neurovascular bundle at the apex of the orbit is isolated, grasped by a curved clamp and divided and ligated. The orbital contents are left attached to the orbital floor

The extended incision allows direct access for division of the vertical and horizontal processes of the malar bone. Thus the maxilla, cheek and lower lid, orbital contents and rim of upper lid are removed *in toto*

The remains of the upper lid assist in lining the roof of the orbit. The rest of the orbit and any other raw area in the operative cavity are covered with Thiersch grafts.

The cavity is packed with a plastic sponge or iodoform gauze





Removal of nasal septum with the maxilla

17 The Gigli saw is passed down one nasal chamber and round the posterior edge of the vomer and pulled forwards by forceps up the other nasal chamber

The saw cut in the septum starts as high as required and then proceeds parallel to the bridge but turns downwards anteriorly to preserve as much of the columellar portion as possible before joining the sublabial incision. Scissors and chisel may be used instead of the saw

The saw is then used to divide the floor of the nasal chamber of the unaffected side in a manner similar to that shown in Illustration 5



Removal of the soft palate with the maxilla

18 Division of the soft palate is avoided whenever possible owing to the difficulty of speaking and the nasal regurgitation which ensue.

Instead of the transverse incision between the hard and soft palate as used in the formal excision, a longitudinal one made with the diathermy divides the soft palate and is continuous with the saw cut which severs the nasal floor

A diathermy incision from behind the tuberosity of the maxilla swings down to loop round the lateral attachment of the soft palate by turning upwards in the nasopharynx.

After mobilizing the maxilla the lateral attachment of the soft palate to the pharynx is separated in the line of this incision so as to ensure complete removal of the neoplastic tissue advancing in this situation.

It is advisable to ligate the external carotid artery in such cases.

An obturator extended to close the nasopharynx is necessary when the soft palate is removed.

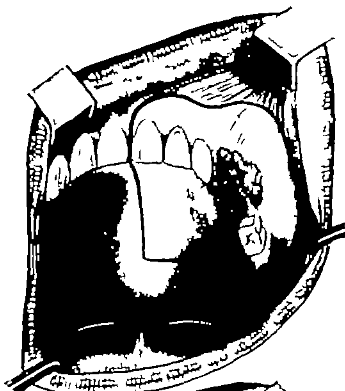
PARTIAL EXCISION

Partial excision is designed for (1) radical removal of the small growths either (*a*) limited to the anterior and lower part of the jaw or (*b*) limited to the inner wall of the antrum or (2) as a procedure prior to irradiation of larger growths of the upper jaw or (3) as a procedure to allow inspection of the antrum following irradiation (palatal fenestration)

Excision of the antero-inferior part of the maxilla

Line of incision

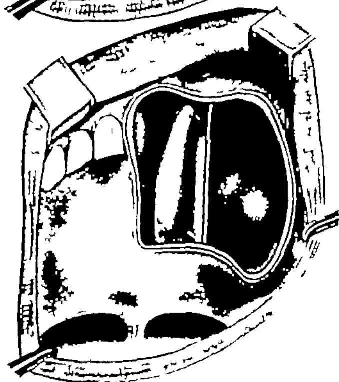
19 The incision made with the diathermy knife passes forwards along the gingivolabial sulcus from in front of the tuberosity to turn down on to the palate by passing between the central incisor teeth. It is then carried backwards just to the affected side of the midline of the hard palate to the junction of the hard with the soft palate. Here it turns outwards to join the start of the incision in front of the tuberosity



Extent of excision

20 A sharp chisel divides the bone in the incision so that the portion of maxilla removed includes the growth. The medial wall of the antrum is trimmed with nibbling forceps as required. The lateral wall should always be taken well up so that the facial muscles can exert a good grip on the prosthesis subsequently fitted. The orbital floor and tuberosity of the maxilla are preserved. A dental plate or temporary prosthesis is inserted.

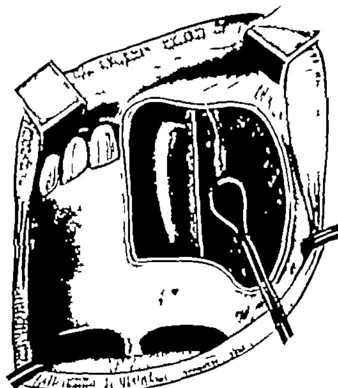
The operation may be modified so as to include a varying portion of the opposite side of palate and alveolus as required.



Excision of the inner wall of the antrum

21 The approach to this situation may be either sublabial as by an expanded form of the Denker operation (see Part XVIII Vol 8) or via a lateral rhinotomy

The former is preferred for very small neoplasms about the front end of the inferior turbinate whilst the latter is more suited to small ones placed somewhat higher



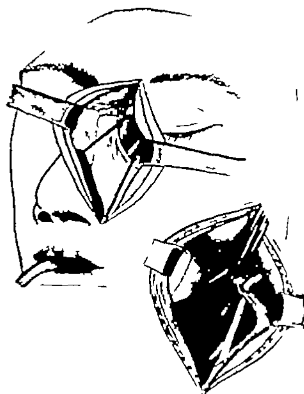
Lateral rhinotomy

22 The incision for lateral rhinotomy is the middle portion of the facial incision employed in the formal excision of the maxilla. The nasal bone the ascending process and adjoining anterior surface of the maxilla and margin of the pyriform opening are laid bare with a rugine. A chisel is then used to break into the nasal cavity and through the adjoining anterior wall of the antrum. Forward biting and side biting forceps enlarge the opening to display the lateral nasal wall so that it may be inspected from the nasal and antral aspects (*inset*) Forceps removal followed by diathermy coagulation completes the excision of the antronasal wall and the skin incision is closed The operation may be followed by intracavitary irradiation in many cases.

Partial excision prior to the irradiation of larger growths of the upper jaw

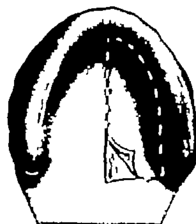
The incision and the removal of the anterior and lower part of the jaw is effected as previously shown (Illustration 21)

Obvious neoplastic tissue is removed with the diathermy loop and suspect areas of the antral walls are subjected to coagulation by the button diathermy if necessary further bone removal being carried out by nibbling and punch forceps. The antrum is packed and a dental plate or temporary prosthesis placed over the pack Irradiation can be started in a few days.



Palatal fenestration

The operation is usually performed two or three weeks after completion of the radiotherapy so that the effect on an antral neoplasm may be assessed and subsequent observation and biopsy facilitated.

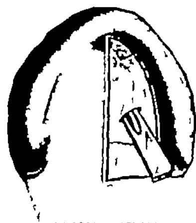


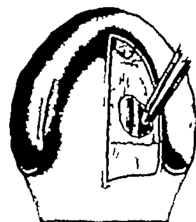
Incision

23 A diathermic incision of the palatal mucosa follows the junction of the hard palate and alveolus. Posteriorly at the junction of the hard and soft palate it turns medially and then proceeds forwards a little to the affected side of the midline.

Removal of mucosa perforation of hard palate

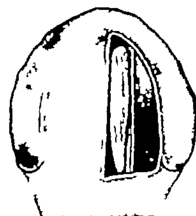
24 The disc of palatal mucosa thus encircled is raised by a curved elevator and removed. Bleeding from the anterior and posterior palatal arteries is controlled by diathermic coagulation. The exposed hard palate is then perforated by a gouge.





Enlargement of opening

25 The resultant opening is enlarged by side biting punch forceps.



Extent of resection

26 Following this enlargement the cavity of both the nasal chamber and the antrum are visible but separated by the inferior border of the inferior turbinate No packing is required and the previously prepared palatal obturator or dental plate is inserted when the patient has regained consciousness.

POST-OPERATIVE CARE AND COMPLICATIONS

Feeding

Usually fluids and semi-solids may be taken at once but in some cases a nasogastric tube is required

Disinfection

Post-operative systemic disinfection by penicillin is maintained for about a week No special local toilet beyond a mouth wash is required.

Removal of the temporary maxillary prosthesis and its replacement

After formal excision the supporting prosthesis should be removed about 8–10 days after the operation cleaned and replaced. As soon as possible after this a new self-retaining prosthesis with teeth attached should be exchanged for the one inserted at operation

Altered position of eye

When the orbital floor has been removed there is a tendency for the eyeball to sink though the use of a properly supported prosthesis reduces this.

Diplopia sometimes results from the displacement and it may be necessary to provide spectacles with appropriate prisms to correct it. However many cases show a surprising degree of spontaneous compensation.

Facial defects

Where facial skin and perhaps the orbital contents have been sacrificed the excellently coloured prostheses now obtainable will restore the appearance These are usually attached to a spectacle frame and can be most realistic.

Care of the cavity

In spite of skin grafting there is often a tendency for mucus to form thick crusts in parts of the cavity

The patient should be taught how to remove these and to keep the cavity clean daily by using an alkaline solution delivered from a Higginson syringe.

[The illustrations for this Chapter on Excision of the Maxilla were drawn by Mr F Price]

Bibliography

Moffett, A. J (1952). *J Laryng* 66, 182.
Ohngren, L. G (1933) *Acta Oto-laryngol.*, Suppl. 19
Passe, E. R. G (1946). *Arch. Oto-laryngol.*, 43, 879
Thomson, St. Clair and Negus, V E. (1955) *Diseases of the Nose and Throat*, 6th Ed., Chapter 22. London Cassell.

EXCISION OF THE MANDIBLE

JOHN F SIMPSON, F.R.C.S.
Surgeon Ear Nose and Throat Department St Mary's Hospital, London

PRE-OPERATIVE

Indications

Malignant disease constitutes almost the sole indication for excision of the mandible.

Conventional irradiation of tumours within or attached to the mandible carries the risk of necrosis and sequestration so that excision is often preferred even though the tumour is thought to be radio-sensitive.

Any cancerous tumour involving the mandible which is considered to be radio-resistant demands excision.

Post-irradiation recurrences are treated likewise and in this respect palliation alone may justify resection.

Squamous carcinoma or adenocarcinoma may invade the bone from the following sites the inferior alveolus buccal mucosa of cheek or floor of mouth tongue tonsil salivary glands overlying skin or lip Malignant growths may also arise in the bone itself. Adamantinoma is probably the commonest of these and being radio-resistant requires excision.

Other tumours originating in the mandible also include the various forms of bone sarcoma and rarely plasmacytoma Excision has been undertaken for a secondary melanosarcomatous deposit.

With modern supervoltage and other newer techniques of radiotherapy it may be possible to control some cases of bone sarcoma However at present excision is more often preferred.

The contra-indications are general and not special

Special equipment or apparatus

Apart from those required to cut the bone no special instruments are required. For this purpose a Gigli saw and a bone drill, preferably an electric dental one, will suffice A chisel and hammer can be employed in the removal of the alveolar portions of the bone in place of the saw

Pre-operative preparation

When bone grafting, immediate or subsequent, is envisaged splinting of the mandible to the upper jaw may be required. Dental caps or anchoring wires should be fixed prior to operation if such are to be used Similarly if a temporary interdental sliding splint to counter inward displacement of the remaining portion of mandible is to be used it should be prepared beforehand.

The removal of carious teeth or those associated with parodontal sepsis can be done either before or at the time of operation. Teeth in the area of jaw to be resected are not extracted.

Cross matching for blood transfusion is advisable in cases where an extensive operation is envisaged.

Systemic disinfection by penicillin should be instituted the day before operation.

Anaesthesia

Inhalation anaesthesia using an endotracheal tube fitted with an inflatable cuff and pilot bag is required. A gauze roll packed lightly round the tube in the pharynx provides safety should the cuff deflate

Position of patient

The patient's position is supine with a flat fenestrated sandbag placed under the head to allow gentle flexion of the neck with the head extended slightly at the occipito-atlantal joint and rotated to the healthy side.

THE OPERATION

Types of resection

1 The site and size of the neoplasm determines the extent of the resection Total mandibulectomy is rarely required One of the following forms of partial excision modified as necessary is selected The resected part may be

(*a*) A portion of the alveolar border

(*b*) The whole or portion of the horizontal ramus (body) of one side

(*c*) The whole or portion of the horizontal rami of both sides, for example middle third of jaw

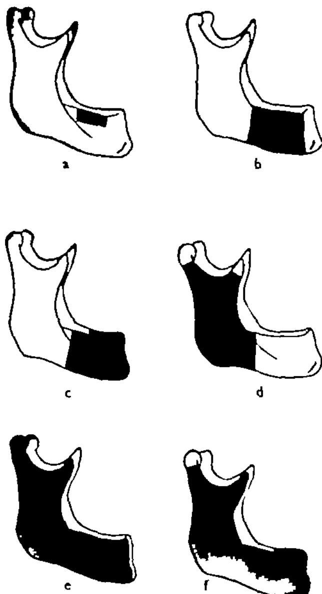
(*d*) The whole or portion of the vertical ramus.

(*e*) Horizontal ramus and vertical ramus, for example, hemimandibulectomy

(*f*) The middle third of the jaw and one vertical ramus.

The submaxillary lymphatic glands and salivary glands should always be removed in any form of mandibular excision for malignancy

When adjacent structures such as cheek, pharynx, tongue, tonsil, parotid gland, are primarily or secondarily involved they and the mandible must be removed together as a monoblock dissection. In these cases it may be necessary to remove the cervical lymphatics from the clavicle upwards in a block dissection at the same time.



The incision

2 For the removal of part or the whole of the horizontal ramus of one side, a curved incision starts immediately below the chin and sweeps downwards and outwards over the great cornu of the hyoid bone to proceed upwards to a point level with but behind the angle of the jaw If the ascending ramus is also to be excised the incision is extended upwards to just below the attachment of the lobule of the ear (dotted line)

If a portion of the opposite side of the mandible is to be resected the anterior end of the incision is extended in the sweep of the curve as far as necessary and the posterior part shortened.



Exposure of the horizontal ramus

3 After the platysma has been incised throughout the incision the flap is raised and drawn upwards.

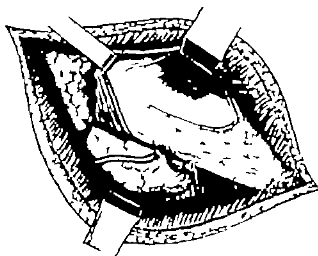
Separation by scissor or scalpel dissection in this plane is carried over the horizontal ramus and the mouth is entered through the mucosa of the inferior gingivo-labial sulcus.

Buccal mucosa must be sacrificed as required so as to circumvent the neoplasm.

The anterior facial vein, and occasionally the anterior division of the posterior facial vein, are ligated as the posterior part of the flap is raised.

The external maxillary (facial) artery is ligated and divided as it crosses the lower border of the mandible.

The flap is pulled upwards by a retractor as shown or by a gauze sling passed through the mouth and out through the opening in the gingivo-labial sulcus.



Removal of a portion of the alveolar border

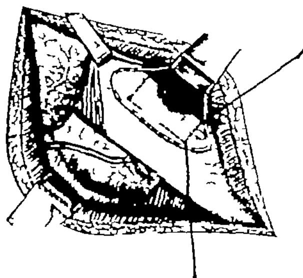
4 This operation is reserved for early cancer clinically limited to the soft tissues of the alveolus.

A drill hole is made on each side of the growth but well clear of it. These two holes are placed in the longitudinal midaxial line of the horizontal ramus.

Vertical cuts are then made upwards through the alveolus from these holes by a Gigli saw.

The drill holes are then joined by a horizontal saw or chisel cut and the segment lifted out.

In extremely early cases of alveolar neoplasm this operation may be carried out intraorally.



Clearance of the submaxillary triangle

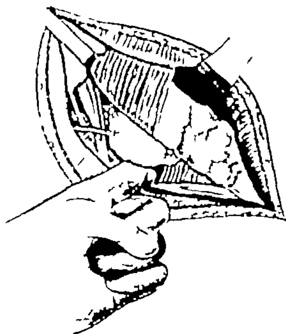
5 The submaxillary lymphatic and salivary glands must be removed *en bloc* when an alveolar cancer demands a sectional resection of the mandible This procedure is advised even in the early cases treated by removal of the alveolar border

The deep fascia is entered at the level of the hyoid bone and the external maxillary (facial) artery is divided as it emerges from under cover of the superior border of the posterior belly of the digastric muscle.

Finger or scissor dissection is continued upwards in the plane between the deep part of the submaxillary gland and the hyoglossus muscle and forwards by tunnelling deep to the posterior border of the mylohyoid muscle

In this manner the mylohyoid and the anterior belly of the digastric muscle are raised on the finger and are then divided horizontally

The hypoglossal nerve accompanied by the ranine veins is seen and respected as it crosses the loop of the lingual artery (*see also* Illustration 6) It lies on the hyoglossus and passes deeply to the posterior border of the mylohyoid muscle



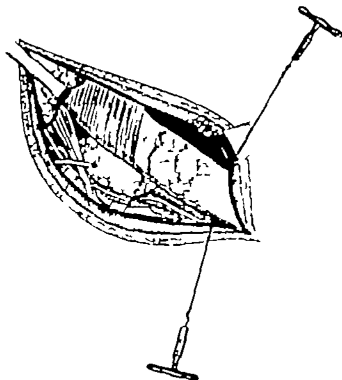
Transection of the horizontal ramus

Anterior transection

6 Dissection upwards with scissors deep to and close to the bone at the chin is carried on until the mucosa of the floor of the mouth is penetrated. A Gigli saw may then be inserted deep to the anterior part of the horizontal ramus.

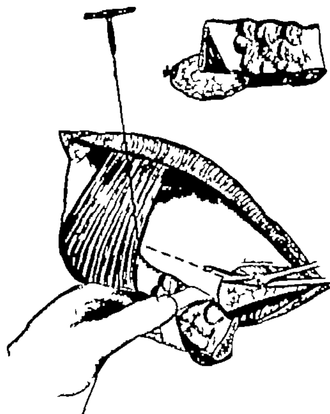
The point of division must be well clear of the growth and if necessary made through the contralateral side of the bone.

It is not usually necessary to extract teeth in order to make the saw cut as interdental spaces may be used.



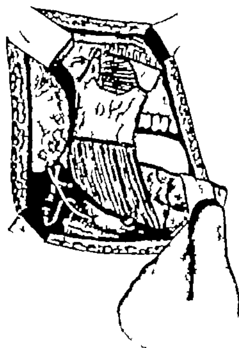
Clearance and posterior transection

7 Outward traction by a gauze sling is made on the free anterior portion to be resected.
The buccal mucosa is thus tensed and is divided from before backwards by scissors.
The mucosa and if necessary the side of the tongue must be sacrificed to give clearance.
Posterior transection by a Gigli saw is made through the horizontal ramus if adequate clearance posterior to the growth can be so obtained. Bone thus isolated is lifted out with submaxillary and salivary glands *en bloc*
Unless the opening of the submaxillary duct is included in the mucosa resected from the floor of the mouth the duct will have been cut across. The sublingual salivary glands may also be resected. It is occasionally expedient to ligate the external carotid artery



Exposure of the external surface of the vertical ramus

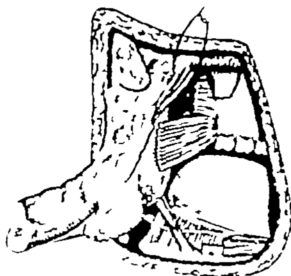
8 For this the incision is extended upwards (*see* Illustration 2) and the flap is retracted upwards and forwards to expose the masseter muscle which is cut across at the desired level, if necessary at its origin from the zygoma.
The tendon of the temporalis muscle is then seen and is detached from the coronoid or the process itself may be severed. This is facilitated by depressing the jaw
The external aspect of the condylar neck and joint capsule are exposed by a rugine which burrows upwards with its edge kept close to the bone to avoid injury to the facial nerve trunk from which it is separated by parotid gland tissue.
For transection at the condylar neck a Gigli saw is passed under it via the coronoid notch.
For disarticulation the insertion of the external pterygoid muscle into the front of the neck and joint capsule is snipped through.
The internal maxillary and superficial temporal arteries are not in danger if the external carotid artery has been ligated.
The joint capsule is entered either above or below the interarticular cartilage and divided so that only its deep fibres remain intact.
A downward pull on the ascending ramus assists the division of the capsule.



9 **Clearance of the deep surface of the vertical ramus**

The horizontal ramus is rotated outwards to show the internal pterygoid muscle which is then detached from the deep surface of the ramus. The inferior dental vessels and nerves are divided with the sphenomandibular ligament.

Finally the deep capsular fibres which alone now hold the mandible are cut and the bone is removed together with the attached submaxillary salivary and lymphatic glands

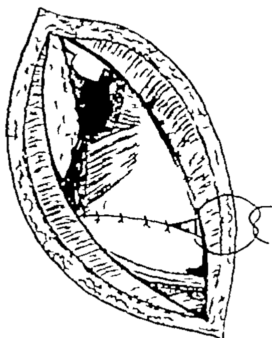


10 **Closure**

The cut edge of the cheek mucosa above is sutured to that of the floor of the mouth and side of tongue below by means of interrupted sutures of hardened catgut. The mucosal closure should be as complete as possible and care must be taken to see that the cut surfaces of the bone are covered by the mucosa.

The space, previously occupied by the jaw between the mucosa and the deep surface of the skin flap is obliterated by interspersed sutures.

The skin edges are closed with interrupted sutures of silkworm or nylon and a rubber tissue drain inserted.



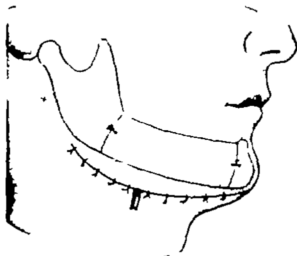
Insertion of a polyvinyl bar

11 When so desired the immediate replacement of the removed section of the jaw by a solid polyvinyl bar can be performed after the buccal mucosa has been completely closed.

Silver wire is passed through drill holes made in the bone ends and secures the polyvinyl bar which has been shaped by a scalpel to fit the gap. No splinting is necessary

Dead space is obliterated as before and the skin edges closed and a drain inserted.

Bone grafting can be performed immediately but is more usually delayed. Bone chips are often used.



MODIFICATIONS AND EXTENSIONS

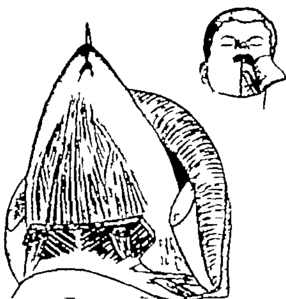
Removal of the middle third (body) of the mandible

12 The incision lies over the hyoid in the midline *and ends at a point behind the angle of the jaw* on both sides.

An additional midline vertical incision to divide the lower lip so forming lateral flaps is sometimes used but is not essential (*inset*)

The submaxillary triangle of each side is cleared as before and resected *en bloc* with the central portion of the mandible The hyoid bone may if desired be included in the resection.

The operation may be extended to include a subtotal or total glossectomy

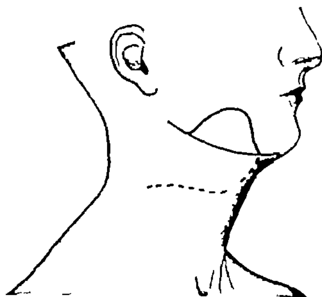


Removal of invaded tissues of face and pharynx attached to the resected bone

13 The usual incision is modified so as to divide and reunite as is necessary to enclose the area of skin and soft tissue to be resected with the bone

When the facial tissues are not to be reflected from the horizontal ramus, the external maxillary (facial) artery is ligated and divided at the upper border of the posterior belly of the digastric muscle as the step following the incision

Sometimes a portion of the lateral pharyngeal wall and if necessary a portion of the hyoid bone, are removed with the jaw and facial tissues.

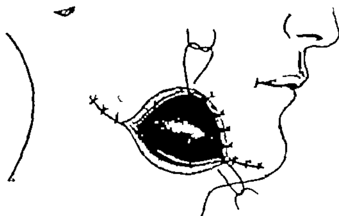


Closure of the resulting defect

14 In some cases the mucosa may be closed and the facial skin defect partly reduced by closing the extremities of the incision. The deficiency if not too large can then be closed by a rotation flap from the neck (*see* dotted line in Illustration 18)

When a large area of soft tissue has been removed a stoma is formed by suturing the edges of the face and neck skin to the edges of the buccal mucous membrane, side of tongue and mucosa of the pharynx, if the latter has been involved.

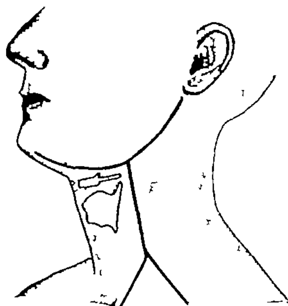
The stoma is closed a month or so later by tube pedicle skin grafting If possible the pedicle should be raised at the time of the excision.



15

Incision for hemimandibulectomy with block dissection of the neck

Cervical block dissection is required if the deep cervical glands are affected and is advisable in the more advanced cases even if the glands are not clinically evident. The gland dissection is carried out from below upwards and precedes the bone resection.



POST-OPERATIVE CARE AND COMPLICATIONS

Asphyxia

When large portions of the mandible have been removed, especially anteriorly the tongue may fall backwards and embarrass respiration after the patient has had the tube removed but is still unconscious. A careful watch must be maintained in order to pull the tongue forward.

Increasing oedema of the tongue may also cause dyspnoea. If any doubt exists as to the patient's safety on this account a tracheostomy must be performed as the last step in the operation.

When mandibulo-maxillary splinting is being used the wires connecting the upper and lower teeth should not be tightened until the patient has passed the stage in which dyspnoea from the above-mentioned causes may occur.

Nasal tube feeding

This is usually required in the case of the larger resections. After 5 or 6 days the patient may be able to take liquid and semi-solid nourishment by mouth.

Systemic penicillin

This is usually kept up for about a week.

Delayed reconstruction

Delayed bone grafting may be performed a month or more after complete healing

The repair of skin defects is carried out by pedicle grafts. Preferably the tube pedicle will have been raised at the time of the mandibulectomy

[*The illustrations for this Chapter on Excision of the Mandible were drawn by Mr F Price*]

Bibliography

Coffin, F (1953) *J Laryng Otol.*, 67 177
Conley J J., and Pack, G. T (1949) *Arch Otolaryng* 50, 518
Martin H., Del Valle, B., Ehrlich, H., and Cahan, W G (1951) *Cancer* 4, 441

CARCINOMA OF TONGUE AND MOUTH

RONALD W RAVEN O B E., T D., F R.C.S

Surgeon Westminster (Gordon) Hospital London Surgeon The Royal Marsden Hospital London

PRE-OPERATIVE

Indications

Partial glossectomy.—Carcinoma of the tip of the tongue carcinoma of the lateral border of the anterior third of the tongue.

Hemi-glossectomy.—Carcinoma of the lateral margin of the tongue at the junction of the anterior two-thirds and posterior third carcinoma of the lateral margin of the posterior third of the tongue radio-resistant carcinoma of the lateral part of the tongue

Total glossectomy.—Diffuse carcinoma of the tongue multiple carcinomas of the tongue carcinoma in the middle of the posterior third of the tongue recurrent carcinoma after partial or hemi-glossectomy carcinoma in a syphilitic or leucoplakic tongue large radio-resistant carcinoma

Glossectomy and excision of the floor of the mouth.—Carcinoma of the tongue infiltrating the floor of the mouth carcinoma of the floor of the mouth infiltrating the tongue

Hemi-glossectomy and excision of the adjacent floor of the mouth.—Carcinoma confined to half the tongue and adjacent floor of the mouth.

Total glossectomy and excision of the floor of the mouth.—Diffuse carcinoma of the tongue and floor of the mouth on both sides.

Excision of the tongue floor of mouth and the mandible.—Carcinoma of the tongue infiltrating the floor of the mouth and the mandible and carcinoma of the floor infiltrating the tongue and mandible.

Position of the patient

The patient lies supine with a low pillow placed between the scapulae the head is extended by lowering the head-piece of the table, and the whole table is tilted to 40 degrees in the reverse Trendelenburg position to minimize venous congestion of the head and neck.

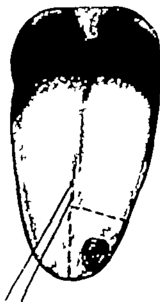
Arrangement of towels

The skin of the neck and face is prepared in the usual way and two towels with a sheet of jaconet are placed under the head. The top towel is then folded to enclose the head from the tip of the mastoid process to the under aspect of the nose. A towel is placed obliquely from each mastoid process to the supra-sternal notch to cover the lateral aspect of the head, and the rest of the patient is covered.

THE OPERATIONS

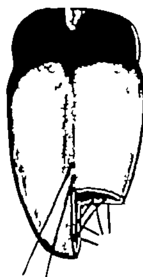
PARTIAL GLOSSECTOMY

The mouth is held wide open by a Mason's gag and a stay suture of nylon is passed through the dorsum of the tongue 5 cm. from the tip to hold the organ in full protrusion.



The incisions

1 Two incisions are made at least 2·5 cm. from the lateral border of the carcinoma to mark out a wedge of tongue containing the tumour. These incisions are deepened through the entire thickness of the tongue.



Removal of the carcinoma

2 The wedge-shaped tissue is removed and haemostasis is secured. The small blood vessels are coagulated by diathermy and the larger ones are secured by suture-ligatures.

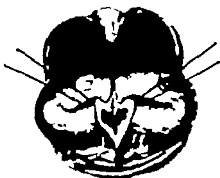


Reconstruction of the tongue

3 The defect in the tongue is closed by suturing the edges of the mucous membrane on the dorsal and ventral surfaces with interrupted sutures of catgut. The wounds in the tongue are then painted with Whitehead's varnish.

HEMI-GLOSSECTOMY

The mouth is held wide open by a Mason's gag and two stay sutures of nylon are passed through the dorsum of the tongue 5 cm from the tip on each side of the mid-line to hold the organ in full protrusion



The incisions

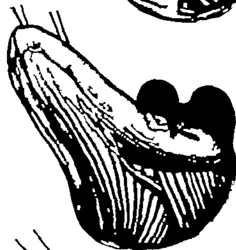
4 A *longitudinal* incision is made with the scalpel through the mucous membrane on the dorsal and ventral aspects of the tongue starting at the tip The median raphé is identified and lateral traction is exerted on the two halves of the tongue by the stay sutures. The tongue is divided on the normal side of the median raphé antero-posteriorly to at least 2 5 cm. beyond the posterior margin of the carcinoma or if necessary to the body of the hyoid bone.

A *lateral* incision is made through the mucous membrane between the tongue and the alveolar process at least 2 5 cm. from the lateral border of the carcinoma. This incision then passes through the mucous membrane covering the anterior faucial pillar to join the midline incision.



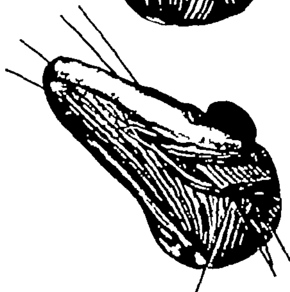
Division of muscles

5 The tongue is retracted forwards and upwards and the genio-hyoglossus muscle is separated from the genial tubercle of the mandible on the affected side. The stylo-glossus muscle forming the anterior faucial pillar is divided next.



Ligation of the lingual artery

6 The tongue is retracted forward, upward and to the opposite side of the lesion and the hyoglossus muscle is identified, a probe-director is passed beneath it and the muscle is then divided. The second part of the lingual artery is now exposed and two ligatures are passed round it with an aneurysm needle and the artery is divided between the tied ligatures.



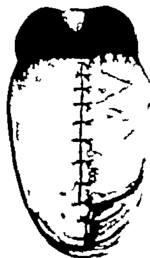
Removal of one half of the tongue

7 The remaining tissues at the root of the tongue are divided transversely at least 2.5 cm. beyond the posterior margin of the carcinoma or if necessary along the upper border of the hyoid bone, and the affected half is removed. Haemostasis is secured by the usual methods.



Reconstruction of the tongue

8 The mucous membrane covering the dorsal and ventral surfaces of the anterior part of the remaining half of the tongue is united with interrupted sutures of catgut. The tongue is allowed to fall back into the mouth and the cut mucous membrane of the floor is sutured to the mucous membrane on the dorsal surface. The wound is painted with Whitehead's varnish.



TOTAL GLOSSECTOMY

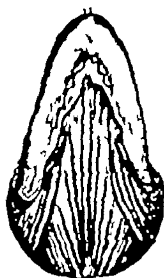
The mouth is held wide open by a Mason's gag and a stay suture of nylon is passed through the dorsum of the tongue 5 cm. from the tip to hold the tongue in full protrusion.

The incisions

9 An incision is made through the mucous membrane at the upper attachment of the fraenum linguae and is carried laterally through the mucous membrane of the floor of the mouth at least 2.5 cm. away from the lateral border of the carcinoma across the anterior faucial pillar to the midline.

A similar incision is made through the mucous membrane of the opposite side.



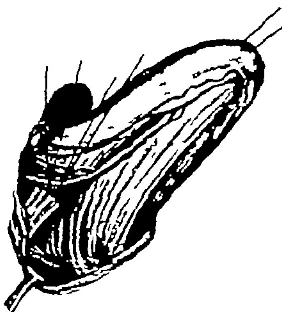


Division of muscles

10 The attachments of the genio-hyoglossus muscles to the genial tubercules of the mandible are divided the stylo-glossus muscles forming the anterior faucial pillars are divided next.

Ligation of the lingual arteries

11 The tongue is retracted forward, upward and to the left side and the right hyoglossus muscle is identified. A probe-director is passed beneath it and the muscle is then divided. The second part of the right lingual artery is now exposed and two ligatures are passed round it with an aneurysm needle and the artery is divided between the tied ligatures. The tongue is then retracted forward, upward and to the right side and the left lingual artery is ligated similarly

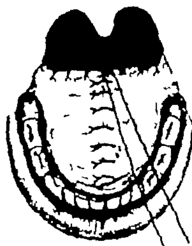


Removal of the tongue

The tongue is retracted forward and the tissues at the root are divided transversely at least 2 5 cm beyond the posterior border of the carcinoma or if necessary along the upper border of the body of the hyoid bone Haemostasis is secured by the usual methods.

Reconstruction of the mucous membrane of the floor of the mouth

12 The cut margins of the divided mucous membrane of the floor of the mouth are sutured with interrupted sutures of catgut. If possible, mucous membrane is sutured over the small stump of the tongue when this is left. A stout nylon suture is passed through the stump of the tongue and brought out on the cheek where it is fixed with adhesive tape. This will prevent it prolapsing back into the hypopharynx. The wounds are painted with Whitehead's varnish By the usual technique a temporary tracheotomy is instituted.



GLOSSECTOMY AND EXCISION OF THE FLOOR OF THE MOUTH

HEMI-GLOSSECTOMY AND EXCISION OF THE ADJACENT FLOOR OF THE MOUTH

The incision

13 The incision divides the mucous membrane of the floor of the mouth along the alveolar process near the bone and 2 5 cm. away from the lateral edge of the carcinoma. It commences at the fraenum linguae and is continued posteriorly across the anterior faucial pillar to the midline of the tongue. The muscles are divided as shown in Illustration 5 and the lingual arteries ligated (Illustrations 6 and 11)

Reconstruction

14 After dividing the tongue the tumour is removed and the reconstruction carried out as shown in Illustrations 8 and 9 A temporary tracheotomy is instituted.

TOTAL GLOSSECTOMY AND EXCISION OF THE FLOOR OF THE MOUTH

The incisions

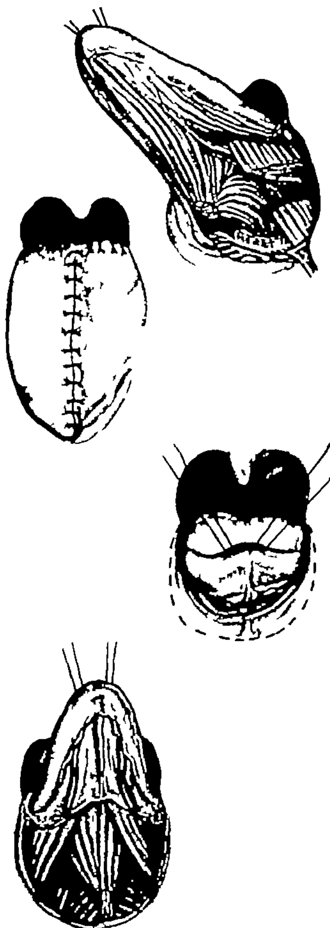
15 An incision is made through the mucous membrane on each side of the floor of the mouth along the alveolar process near the mandible and as far away as possible from the lateral edge of the carcinoma. This is continued transversely across the anterior faucial pillar to the midline of the tongue.

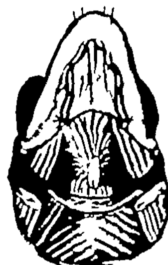
Division of muscles

16 The attachments of the following muscles to the inner aspect of the mandible are divided on both sides commencing anteriorly genio-hyoglossus, genio-hyoid and mylo-hyoid. The whole of the floor of the mouth is mobilized for excision with the tongue The stylo-glossus muscles are divided next.

The tongue is retracted forward, upward and to the left side and the right hyoglossus muscle is identified and divided to expose the right lingual artery which is then divided between ligatures.

The left lingual artery is divided similarly



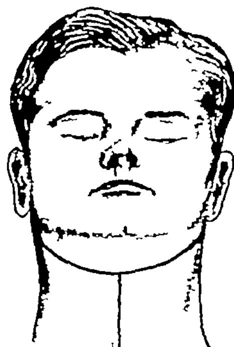


Removal of the tongue and floor of the mouth

17 The tongue is retracted forward and the tissues at the root are divided transversely at least 2.5 cm. beyond the posterior border of the carcinoma or, if necessary, along the upper border of the body of the hyoid bone. The tongue and floor of the mouth are removed and haemostasis is secured. The wound is packed lightly with gauze impregnated with liquid paraffin. A temporary tracheotomy is instituted.

EXCISION OF THE TONGUE, FLOOR OF THE MOUTH AND THE MANDIBLE

The primary disease in the mouth is removed in continuity with the cervical lymphatic vessels and lymph nodes as a monoblock operation.



The incisions

18 A curved incision is made in the skin of the neck from the tip of one mastoid process to the other; its maximum convexity reaches the body of the hyoid bone. A second incision is made in the midline of the neck from the body of the hyoid bone to the supra-sternal notch.



Reflection of the skin flaps

19 The upper skin flap is reflected upwards off the platysma muscle to the upper border of the outer aspect of the mandible including the angles. The lower and outer skin flap on the side where a radical block dissection of the cervical lymphatics is required is reflected off the platysma muscle as far as the anterior border of the trapezius muscle and upper border of the clavicle. Where the primary carcinoma involves tissues across the midline of the mouth, the lymphatics in this side of the neck will be excised similarly but conserving this internal jugular vein.

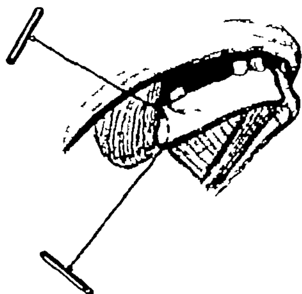


Block dissection of the cervical lymph nodes and vessels

20 This standard procedure is performed by commencing the dissection at the root of the neck so that the lymphatics and the primary carcinoma will be removed together in continuity

Ligation of both lingual arteries, and the facial artery on the affected side

21 This is done at the end of the block dissection of the neck the arteries are ligated and divided at their origin from the external carotid artery



Resection of a portion of the mandible

22 The portion of the mandible infiltrated by the carcinoma is defined and the decision is made regarding the extent of bone to be excised. In some patients the whole of the mandible is resected the bone is divided on the same side immediately lateral to the symphysis menti and the temporo-mandibular joint is dislocated. In others the horizontal ramus is excised. Having defined the limits of the carcinoma the mandible is resected at least 2 5 cm. on either side of the edge of the tumour The tooth at each line of resection is extracted and the mucous membrane on the inner side of the mandible is incised in both positions to permit the passage of a Gigli saw to sever the affected portion of the mandible from the rest.

The anterior end of the resected mandible is retracted outwards and a good exposure of the inside of the mouth is obtained so that the extent of the disease can be determined accurately

Removal of the tongue and affected half of the floor of the mouth



23 An incision is then made through the mucous membrane of the opposite side of the floor of the mouth at least 2.5 cm. from the edge of the carcinoma, passing across the anterior faucial pillar to the midline of the tongue. The mucous membrane over the anterior faucial pillar on the affected side is then divided 2.5 cm. away from the edge of the carcinoma.

Division of muscles

24 *On the normal side of the mandible.*—The attachment of the genio-hyoglossus muscle to the genial tubercle of the mandible is divided followed by the stylo-glossus muscle forming the anterior faucial pillar and the hyoglossus muscle. The lingual artery is divided between ligatures.

On the affected side of the mandible.—The hyoid attachments of the genio-hyoglossus, hyoglossus and mylohyoid muscles are divided and the stylo-glossus muscle is severed.

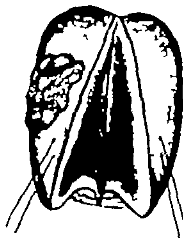


Removal of the tongue

The tongue is retracted forward and any remaining tissues at the root are divided transversely 2.5 cm. beyond the posterior border of the carcinoma or if necessary along the upper border of the hyoid bone. The affected tissues, including the tongue, affected side of the floor of the mouth and mandible are removed with the lymphatic vessels and nodes as a monoblock operation.

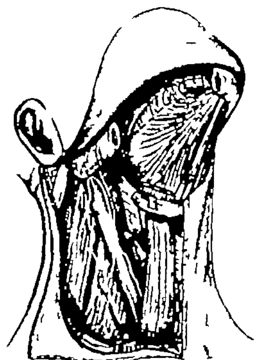
Carcinoma confined to one side

25 When the carcinoma is confined to one half of the tongue a hemi-glossectomy is performed by dividing the organ antero-posteriorly along the opposite side of the median raphé as described under Hemi-glossectomy.



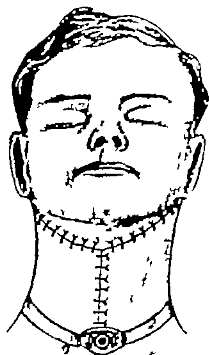
Reconstruction of the floor of the mouth

26 The mucous membrane that remains is utilized as far as possible to cover the raw area of the mandible and of the floor of the mouth by suturing its edges together with interrupted sutures of catgut. More tissue is available for the reconstruction after a hemiglossectomy is done. Haemostasis in the mouth is secured and the wound in the mouth is packed lightly with gauze impregnated with liquid paraffin.



Temporary tracheotomy

This essential part of the operation is now performed.



Closure of the wound

27 Haemostasis in the neck is secured and penicillin-sulphathiazole powder is placed in the wound. The skin flaps are sutured back in their normal positions and adequate drainage of the neck and submandibular regions is established.

SPECIAL POST-OPERATIVE CARE

Position in bed

The patient is placed in the supine position with the head turned to the side to permit any blood and saliva to escape from the mouth on to a pad of wool to prevent soiling of the pillow When blood or mucus collects in the mouth it is swabbed out or aspirated, care being taken not to irritate the pharynx when this is done or swallowing movements will take place

Prevention of prolapse of the stump of the tongue into the hypopharynx

If prolapse occurs respiration will be impeded to prevent it a stout suture of nylon is passed through the stump of the tongue if this remains at the end of the operation, and fixed to the outer side of the cheek by a piece of adhesive plaster

Maintenance of nutrition

During the initial 24 hours after the operation fluids are administered rectally or intravenously depending upon the patient's condition and requirements. After this period swallowing may be possible otherwise feeding through a nasal tube is commenced.

Toilet of the mouth

The mouth is kept clean by irrigating it with a solution of potassium permanganate (strength 1 in 5 000) For this purpose an atomizer is used or when this is not available, syringing is done through a rubber tube fitted to a glass syringe or a Higginson's syringe When the discharge from the mouth is thick in consistency it is swabbed away with pieces of wool soaked in a solution of potassium permanganate

Removal of the tracheotomy tube

The tracheotomy tube can be removed after 1 week usually when the oedema has subsided.

[The illustrations for this Chapter on Carcinoma of the Tongue and Mouth were drawn by Mr J Wheldon]

Bibliography

Butlin, H. T (1885). *Diseases of the Tongue* Philadelphia Lea.

Fitzwilliams, D C. L. (1927). *The Tongue and Its Diseases.* Oxford Oxford Medical Press.

Jamieson, J K., and Dobson, J F (1920-21). *Brit J Surg.*, 8, 80

Kremen, A. J (1951). *Surgery* 30 227

Martin, H. E. (1940) *Arch Surg.*, 41, 888.

Power D'arcy (1918-19). *Brit. J Surg.*, 6, 836.

Spencer W G and Cade, Stanford (1931). *Diseases of the Tongue* London Lewis.

Trotter W (1913). *Lancet* 1, 1075 1141

Ward, G E., and Hendrick, J W (1950). *Tumors of the Head and Neck* Baltimore Williams & Wilkins.

EPITHELIOMA OF THE LIP

RONALD W RAVEN O.B.E., T.D., F R C S

Surgeon Westminster (Gordon) Hospital, London Surgeon The Royal Marsden Hospital, London

PRE-OPERATIVE

Indications

Wedge excision of lip —A small carcinoma localized in the lip

Extensive resection of the lip —A large carcinoma affecting the whole thickness of the lip

Partial resection of the lip and jaw —Carcinoma of the lip infiltrating the maxilla or mandible

When carcinoma involves the angle of the mouth, wedge excision may be performed. The technique is the same as for wedge excision of the lip

Special pre-operative preparation

All carious teeth should be extracted and pyorrhoea alveolaris treated any respiratory infection should be cleared up and breathing exercises instituted The patient should be familiarized with nasal feeding when necessary

Anaesthesia

Pre-medication —This should not be depressing so that at the end of the operation the laryngeal and swallowing reflexes will have returned. Depending upon the age and physical condition of the patient morphine $\frac{1}{8}$–$\frac{1}{4}$ gr (8–16 mg) with atropine $\frac{1}{100}$ gr (0·6 mg) are injected hypodermically $\frac{1}{2}$ hour before the operation. Under the age of 65 years, Omnopon $\frac{1}{3}$ gr (20 mg) and scopolamine $\frac{1}{150}$ gr (0·4 mg) injected hypodermically 1 hour before operation is satisfactory

Induction —Intravenous thiopentone (5 per cent solution) up to 0 5 g followed by scoline 1–2 ml (50–100 mg) to facilitate the introduction of an endotracheal tube by direct laryngoscopy and to lessen the risk of injury to the growth or of dislodging part of it, is the method of choice

Normally the nasal route is chosen for the introduction of the endotracheal tube, to give the surgeon free access to the site of the operation.

The pharynx is thoroughly packed with gauze moistened with a solution of normal saline

Maintenance —Anaesthesia is maintained by the administration of nitrous oxide and oxygen, with the addition of a minimum concentration of trichlorethylene. Intermittent intravenous injections of pethidine hydrochloride (20–40 mg) may be necessary to settle the patient.

Short operations

In short operations to remove small tumours on the lip or anterior part of the tongue, excision may be performed with the same pre-medication and intermittent intravenous injections of thiopentone in small quantities.

Position of the patient

The patient lies supine with a low pillow placed between the scapulae, the head is extended by lowering the head-piece of the table and the whole table is tilted to 40 degrees in the reverse Trendelenburg position to minimize venous congestion of the head and neck.

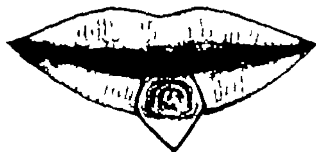
Arrangement of towels —The skin of the neck and face is prepared in the usual way and two towels with a sheet of jaconet are placed under the head. The top towel is then folded to enclose the head and upper half of the face. Another towel is placed over the chest and anterior aspect of the neck and the rest of the patient is covered.

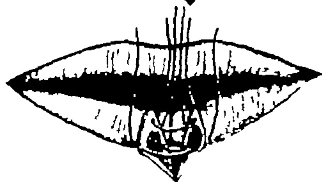
THE OPERATIONS

WEDGE EXCISION OF LIP

The incisions

1 Two incisions are made through the whole thickness of the lip on each side of the carcinoma at least 1 cm beyond its lateral margins. These incisions join 1 cm below the tumour and mark out a wedge of tissue which is removed





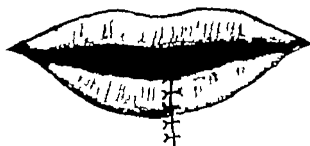
Reconstruction of the lip

Introduction of sutures

2 Haemostasis is secured and fine nylon sutures are introduced.

Closure

3 The muco-cutaneous junctions are then approximated, followed by the edges of the mucous membrane and finally the skin edges



EXTENSIVE RESECTION OF THE LIP

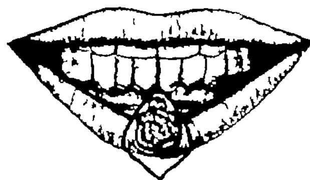
The basic technique is the same as described for a wedge excision of a carcinoma Plastic procedures are necessary to reconstruct the lip

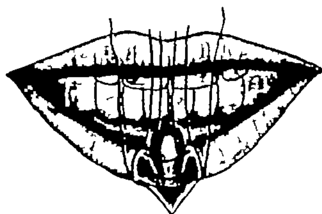
PARTIAL RESECTION OF THE LIP AND JAW

The mouth is held open by a Mason's gag It may be necessary to extract teeth on each side of the tumour where the jaw will be divided.

The incisions

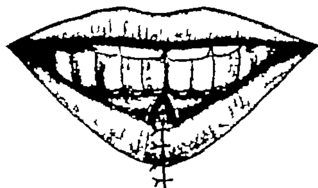
4 An incision is made at least 1 cm. from the edge of the carcinoma through the skin of the lip on both sides of the tumour These commence 1 cm from the lower border of the tumour and diverge to enclose it. They are continued through the mucous membrane of the lip and periosteum of the bone 1 cm. from the edge of the growth infiltrating the jaw





Partial excision of the jaw

5 The limits of the area infiltrated by the carcinoma are defined so that it will be removed completely Excision of a wedge-shaped area of bone may suffice but if necessary a wider segment should be removed.



Reconstruction of the lip

6 This is carried out as is mentioned under Wedge Excision of the Lip alternatively plastic procedures may be required.

SPECIAL POST-OPERATIVE CARE

Maintenance of nutrition

For the initial 24 hours after the operation the patient s nutrition is maintained by fluid given rectally After this period oral feeding may be resumed, but if this is difficult nasal feeding is instituted.

Toilet of the mouth

The mouth is kept clean by using mouth washes of a solution of potassium permanganate (strength 1 in 5 000) at frequent intervals.

Removal of sutures

The sutures are usually removed on the fifth post-operative day

[The illustrations for this Chapter on Epithelioma of the Lip were drawn by Mr J Wheldon]

Bibliography

McClure, R. D., and Lam, C. R. (1947). *Ann. Surg.*, **125**, 658.
Maroon, S L., and Kennedy R. H. (1949) *Ann. Surg* **130**, 806.
Martin, H. E. (1935). *Amer J Surg.*, **30** 215
Ward, G E., and Hendrick, J W (1950). *Tumors of the Head and Neck* Baltimore Williams & Wilkins.

SIALOGRAPHY

J N Pattinson M B D M R D F F R

Radiologist Middlesex Hospital London

PRE-OPERATIVE

Indications and contra-indications

Sialography is of value in the differential diagnosis of swellings in the region of the salivary glands The commoner conditions in which the examination may provide useful information are as follows.

Obstruction of the duct due to stricture calculus or foreign body—Identification of the site of the lesion may influence the choice of treatment

Subacute and chronic inflammations.—The degree of damage to the ducts and glands can be shown

Neoplasms—The extent of involvement of the gland by a neoplasm can be assessed although little help can be obtained regarding the histological type of the tumour In some cases it can be shown that the swelling is not caused by the salivary gland but by an adjacent structure

External fistulae—Demonstration of the site of the communication of the fistula with the duct is helpful in planning treatment.

In acute parotitis, sialography is painful it may aggravate the condition and it is unnecessary

Apparatus

The examination can be carried out with the patient supine or seated The use of a Schonander or similar type of radiographic skull table will facilitate accurate positioning and allows the use of a small cone with resultant improvement in film quality

Cannulae—A blunt ended silver lachrymal cannula is recommended. This may be curved as required. A small "olive" of solder attached 1 cm. or so from the tip will prevent reflux of contrast medium.

Syringe—A lightweight Record or all-glass 2 ml. hypodermic syringe is suitable.

Dilators.—Silver lachrymal duct dilators are rarely necessary but are occasionally useful for submandibular duct examinations.

Contrast media

Neohydriol 40 per cent, is the most widely used and the most generally satisfactory medium. It is non-irritant and is of suitable viscosity and radio-opacity

Dosage—An initial injection of 0·25 ml. in a child, or 0·5 ml. in an adult, is recommended followed by the inspection of antero-posterior and lateral radiographs. This amount is adequate to fill the normal parotid duct and its branches and to demonstrate or exclude the condition known as sialectasis, or congenital sialangiectasis. The latter is characterized by appearance of multiple small spherical collections of contrast medium throughout the parotid gland. If this picture is obtained, injection of additional Neohydriol is inadvisable, for Thackray (1955) has shown that many of the spherical opacities are globules of Neohydriol which have escaped into the stroma of the gland following rupture of duct walls. Portions of the walls of the minor ducts are defective and extravasation is not due to forceful injection. The Neohydriol remains in the stroma for months or years and provokes a chronic inflammatory reaction.

Provided sialectasis has been excluded, additional contrast medium should be injected if the main parotid duct is dilated and also if a tumour is suspected. In the latter case, an attempt should be made to fill the acini in order that the limits of the unaffected portion of the gland may be defined.

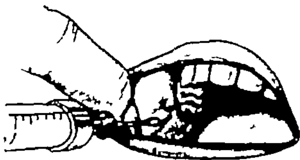
A slight feeling of fullness in the parotid region is usually experienced by the patient after injecting 0·25–0 5 ml. The injection should be terminated if pain is felt.

Preliminary radiographs will confirm or exclude the presence of radio-opaque calculi or calcification.

PAROTID SIALOGRAM

Positioning

1 When the examination is performed in the x-ray department, the patient may conveniently be placed in position for subsequent radiography The head is turned approximately 5 degrees from the true sagittal plane towards the affected side The x-ray tube is centred through the gland 2 cm deep to the skin surface and 2 cm. below the external auditory meatus. The orifice of the duct is on the oral surface of the cheek opposite the crown of the second molar it is slit-like or circular and lies near the summit of a papilla of varying prominence. This papilla may be absent. The orifice can be identified if necessary by producing a flow of saliva either by massage of the gland or by placing a few drops of 0 5 per cent hydrochloric acid or lemon juice in the mouth



Injection

2 *The cannula, attached to the syringe, is inserted* into the duct until the olive" occludes the duct orifice Contrast medium is injected slowly and gently The patient then closes the mouth with the cannula *in situ* holding the syringe gently between the jaws. This method prevents any reflux of the contrast medium and so allows accurate measurement of the amount injected. Superimposition of the images of contrast medium in the mouth and pharynx and that in the ducts is also avoided. Immediately following the injection the antero-posterior radiograph is taken. The head, with chin extended, is then turned into the true lateral position, the affected side being placed nearest to the film. The x ray tube is centred through the angle of the jaw and the exposure made. Early examination of the films will indicate any need for more contrast medium.



Radiographic factors

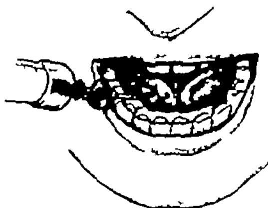
	kV	*mA*	*Seconds*	*Anode-Film distance*
A.P Position	69	150	0 1	70 cm.
Lateral Positions	72–75	150	0·1	70 cm.

(Standard screens—Potter Buckey)

SUBMANDIBULAR SIALOGRAM

Position

3 A convenient method is to place the patient supine with the head in the sagittal plane After opening the mouth the patient presses the tip of the tongue up against the hard palate The orifice of the submandibular duct lies on the summit of a small papilla at the side of the frenulum linguae. The orifice is small and is often difficult to identify unless a flow of saliva is obtained In order to insert the lachrymal type of cannula it may be necessary to use the graduated silver dilators. Alternatively very fine cannulae, made by rounding off the tip of a No 20 hypodermic needle may be employed. Very firm pressure will then be required to inject the Neohydriol



Injection

4 Sialectasis has not been recorded in the submandibular glands and therefore a larger quantity of contrast medium may be injected initially with safety than in a parotid sialogram. The average amount needed is 1–1·5 ml for apart from the orifice, the diameter of Wharton's duct is larger than that of Stensen's duct. Following the injection, the head may be positioned for radiography while the operator supports the syringe and cannula *in situ* or the cannula may be withdrawn and a small piece of gauze applied over the duct orifice. The gauze is removed immediately before the radiograph is taken. The head is turned into the true lateral position with chin extended and the affected side nearest to the film.



Radiographic view

5 The x-ray tube is centred on the inferior margin of the horizontal ramus of the mandible, 8 cm. anterior to the angle of the jaw. It is advantageous to obtain an additional view and the oblique lateral position may be used. If a radiographic skull table is employed it is a simple matter to adjust the x-ray tube so that the central ray is directed 20 degrees cranially. The same centring point used for the lateral position is retained and the patient's head is not moved.

An occlusal view is helpful in certain cases to show Wharton's duct. It is obtained by placing an occlusal film in the patient's mouth. The jaw is then closed and the chin fully extended with the head in the sagittal plane. The x-ray tube is centred in the midline between the horizontal rami of the mandible and 2 cm posterior to the symphysis menti.



Radiographic factors

	kV	*mA*	*Seconds*	*Anode-Film distance*
Lateral Position	64	150	0·1	70 cm.
Oblique Lateral	58	150	0·1	70 cm.
(Standard screens—Potter Bucky)				
Occlusal	48	200	0·5	70 cm.
(Non-screen film—No Potter Bucky)				

[The illustrations for this Chapter on Sialography were drawn by Mr J Wheldon.]

Reference

Thackray A. C (1965). *Arch. Middx Hosp* 5, 151

OPERATIONS ON THE PAROTID GLAND

DAVID H PATEY M.S., F.R.C.S

Surgeon Middlesex Hospital

PRE-OPERATIVE

In this Chapter the operations of conservative and radical parotidectomy enlargement of the parotid orifice, and drainage of a parotid abscess are described

Indications

Conservative parotidectomy

Conservative parotidectomy may be defined as removal of part or the whole of the parotid gland with c servation of the facial nerve. The chief indication is mixed parotid tumour The operation may also be feasible early cases of carcinoma of the parotid. In more advanced cases of carcinoma, radical removal with sacrifice of facial nerve is more usually indicated.

Other indications for conservative parotidectomy are other tumours of the parotid such as adeno-lymphoma angioma, cysts, tuberculosis, and occasional cases of chronic parotitis and diffuse parotid calculi. Removal of parotid gland may also be indicated in obstinate cases of duct fistula. In most cases of chronic parotid swelling exact diagnosis is not possible before exploration and it is advantageous to have arrangements for microscopic examination during operation in case the macroscopical findings are equivocal.

Radical parotidectomy

Radical parotidectomy which may be defined as removal of the parotid with sacrifice of the facial nerve, usually only carried out in cases of carcinoma of the parotid with such a degree of spread that preservation of t facial nerve is impossible. It is often combined with a block dissection of the neck.

Apart from an associated block dissection of the neck, other local structures may have to be removed as by the spread of the growth, for example, the upper end of the sternomastoid, the mastoid process, the ligmous external auditory meatus, the masseter muscle, the ligaments of the temporo-mandibular joint, and tl posterior belly of the digastric muscle.

Enlargement of the parotid duct orifice

Enlargement may be necessary to enable a calculus in the parotid duct to pass or be extracted. It may also helpful in those cases of recurrent parotitis due to stricture of the duct orifice and associated dilatation of the duct.

The operation, though in theory very easy is in practice often difficult owing to the delicacy of the duct. times further narrowing rather than enlargement of the orifice results, so that the operation should not be undertaken.

Drainage of parotid abscess

With the markedly diminished frequency of acute parotitis and the advent of chemotherapy this operation now not often required. If, however there are clinical or sialographic signs of parotid abscess, drainage must undertaken.

Pre-operative preparation

The hair in the temporal and occipital regions is shaved for a distance of 1-2 inches from the ear prior to servative or radical parotidectomy and drainage of a parotid abscess.

Anaesthesia and special aids

General anaesthesia with intratracheal tube and packing off the pharynx is most satisfactory Magnifyir spectacles for the identification of the facial nerve and its branches are required.

Radiographic view

5 The x ray tube is centred on the inferior margin of the horizontal ramus of the mandible, 8 cm. anterior to the angle of the jaw It is advantageous to obtain an additional view and the oblique lateral position may be used. If a radiographic skull table is employed it is a simple matter to adjust the x-ray tube so that the central ray is directed 20 degrees cranially The same centring point used for the lateral position is retained and the patient's head is not moved.



An occlusal view is helpful in certain cases to show Wharton's duct. It is obtained by placing an occlusal film in the patient's mouth. The jaw is then closed and the chin fully extended with the head in the sagittal plane The x ray tube is centred in the midline between the horizontal rami of the mandible and 2 cm posterior to the symphysis menti

Radiographic factors

	kV	*mA*	*Seconds*	*Anode Film distance*
Lateral Position	64	150	0 1	70 cm.
Oblique Lateral	58	150	0 1	70 cm.
(Standard screens—Potter Bucky)				
Occlusal	48	200	0 5	70 cm.
(Non-screen film—No Potter Bucky)				

[*The illustrations for this Chapter on Sialography were drawn by Mr J Wheldon*]

Reference

Thackray A C. (1955). *Arch Middx Hosp.*, 5, 151

OPERATIONS ON THE PAROTID GLAND

DAVID H PATEY M.S., F.R.C.S

Surgeon Middlesex Hospital

PRE-OPERATIVE

In this Chapter the operations of conservative and radical parotidectomy enlargement of the parotid duct orifice, and drainage of a parotid abscess are described

Indications

Conservative parotidectomy

Conservative parotidectomy may be defined as removal of part or the whole of the parotid gland with conservation of the facial nerve The chief indication is mixed parotid tumour The operation may also be feasible in early cases of carcinoma of the parotid. In more advanced cases of carcinoma radical removal with sacrifice of the facial nerve is more usually indicated

Other indications for conservative parotidectomy are other tumours of the parotid such as adeno-lymphoma and angioma, cysts tuberculosis, and occasional cases of chronic parotitis and diffuse parotid calculi Removal of the parotid gland may also be indicated in obstinate cases of duct fistula. In most cases of chronic parotid swelling, an exact diagnosis is not possible before exploration, and it is advantageous to have arrangements for immediate microscopic examination during operation in case the macroscopical findings are equivocal

Radical parotidectomy

Radical parotidectomy which may be defined as removal of the parotid with sacrifice of the facial nerve is usually only carried out in cases of carcinoma of the parotid with such a degree of spread that preservation of the facial nerve is impossible. It is often combined with a block dissection of the neck.

Apart from an associated block dissection of the neck, other local structures may have to be removed as indicated by the spread of the growth, for example the upper end of the sternomastoid, the mastoid process, the cartilaginous external auditory meatus, the masseter muscle the ligaments of the temporo-mandibular joint, and the posterior belly of the digastric muscle

Enlargement of the parotid duct orifice

Enlargement may be necessary to enable a calculus in the parotid duct to pass or be extracted. It may also be helpful in those cases of recurrent parotitis due to stricture of the duct orifice and associated dilatation of the main duct.

The operation, though in theory very easy is in practice often difficult owing to the delicacy of the duct. Sometimes further narrowing rather than enlargement of the orifice results, so that the operation should not be lightly undertaken.

Drainage of parotid abscess

With the markedly diminished frequency of acute parotitis and the advent of chemotherapy this operation is now not often required. If, however there are clinical or sialographic signs of parotid abscess, drainage must be undertaken.

Pre-operative preparation

The hair in the temporal and occipital regions is shaved for a distance of 1-2 inches from the ear *prior to* conservative or radical parotidectomy and drainage of a parotid abscess.

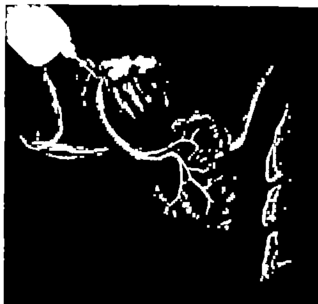
Anaesthesia and special aids

General anaesthesia with intratracheal tube and packing off the pharynx is most satisfactory Magnifying spectacles for the identification of the facial nerve and its branches are required.

Radiographic view

5 The x ray tube is centred on the inferior margin of the horizontal ramus of the mandible, 8 cm. anterior to the angle of the jaw It is advantageous to obtain an additional view and the oblique lateral position may be used. If a radiographic skull table is employed it is a simple matter to adjust the x-ray tube so that the central ray is directed 20 degrees cranially The same centring point used for the lateral position is retained and the patient's head is not moved.

An occlusal view is helpful in certain cases to show Wharton's duct. It is obtained by placing an occlusal film in the patient's mouth The jaw is then closed and the chin fully extended with the head in the sagittal plane. The x-ray tube is centred in the midline between the horizontal rami of the mandible and 2 cm posterior to the symphysis menti.



Radiographic factors

	kV	mA	Seconds	Anode-Film distance
Lateral Position	64	150	0 1	70 cm.
Oblique Lateral	58	150	0·1	70 cm.
(Standard screens—Potter Buckey)				
Occlusal	48	200	0·5	70 cm.
(Non-screen film—No Potter Buckey)				

[The illustrations for this Chapter on Sialography were drawn by Mr J Wheldon]

Reference

Thackray A. C. (1955). *Arch. Middx Hosp* **5**, 151

OPERATIONS ON THE PAROTID GLAND

DAVID H PATEY, M.S., F.R.C.S.

Surgeon Middlesex Hospital

PRE-OPERATIVE

In this Chapter the operations of conservative and radical parotidectomy enlargement of the parotid duct orifice, and drainage of a parotid abscess are described.

Indications

Conservative parotidectomy

Conservative parotidectomy may be defined as removal of part or the whole of the parotid gland with conservation of the facial nerve The chief indication is mixed parotid tumour The operation may also be feasible in early cases of carcinoma of the parotid. In more advanced cases of carcinoma, radical removal with sacrifice of the facial nerve is more usually indicated.

Other indications for conservative parotidectomy are other tumours of the parotid such as adeno-lymphoma and angioma, cysts, tuberculosis, and occasional cases of chronic parotitis and diffuse parotid calculi. Removal of the parotid gland may also be indicated in obstinate cases of duct fistula. In most cases of chronic parotid swelling an exact diagnosis is not possible before exploration, and it is advantageous to have arrangements for immediate microscopic examination during operation in case the macroscopical findings are equivocal

Radical parotidectomy

Radical parotidectomy which may be defined as removal of the parotid with sacrifice of the facial nerve, is usually only carried out in cases of carcinoma of the parotid with such a degree of spread that preservation of the facial nerve is impossible It is often combined with a block dissection of the neck.

Apart from an associated block dissection of the neck, other local structures may have to be removed as indicated by the spread of the growth, for example, the upper end of the sternomastoid, the mastoid process, the cartilaginous external auditory meatus, the masseter muscle, the ligaments of the temporo-mandibular joint, and the posterior belly of the digastric muscle

Enlargement of the parotid duct orifice

Enlargement may be necessary to enable a calculus in the parotid duct to pass or be extracted. It may also be helpful in those cases of recurrent parotitis due to stricture of the duct orifice and associated dilatation of the main duct.

The operation, though in theory very easy is in practice often difficult owing to the delicacy of the duct. Sometimes further narrowing rather than enlargement of the orifice results, so that the operation should not be lightly undertaken.

Drainage of parotid abscess

With the markedly diminished frequency of acute parotitis and the advent of chemotherapy this operation is now not often required. If, however there are clinical or sialographic signs of parotid abscess, drainage must be undertaken.

Pre-operative preparation

The hair in the temporal and occipital regions is shaved for a distance of 1–2 inches from the ear prior to conservative or radical parotidectomy and drainage of a parotid abscess.

Anaesthesia and special aids

General anaesthesia with intratracheal tube and packing off the pharynx is most satisfactory Magnifying spectacles for the identification of the facial nerve and its branches are required.

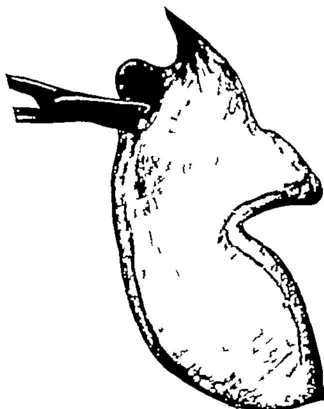


THE OPERATIONS

CONSERVATIVE PAROTIDECTOMY

The incision

1 The incision is composed of a vertical part along the line of the pre-auricular skin crease, and an oblique part in the upper skin crease of the neck, the two joining below and behind the ear. It is advantageous to mark out the line of incision accurately before starting the operation. The injection of a dilute solution of adrenaline (1 : 800 000) subcutaneously into the operation area diminishes superficial bleeding.



Deepening of the incision

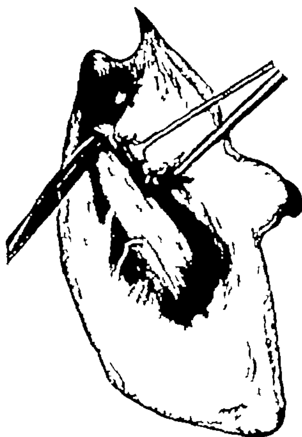
2 The incision is deepened in the upper part to the parotid fascia, and in the lower part to divide the platysma muscle. The anterior flap is at first only dissected forwards for a short distance. The parotid fascia is incised immediately below and anterior to the external auditory meatus, and the plane of cleavage between the cartilaginous external auditory meatus and the parotid gland opened up with blunt-pointed curved scissors.



Dissection of parotid fascia and tissue

3 The parotid fascia and glandular tissue which extends over the upper end of the sternomastoid muscle is divided and dissected forwards until the anterior edge of the muscle is identified. During the course of the dissection the great auricular nerve and external jugular vein are identified and divided. The anterior edge of the sternomastoid muscle is freed up to the mastoid process.

Further experience has shown that it is best to preserve the external jugular vein as not only diminishing venous bleeding, but also as an aid to identification of the lower branches of the facial nerve which cross superficial to the vein in the gland.



Identification of the trunk of the facial nerve

4 The digastric muscle is identified in the anterior triangle of the neck and its posterior belly traced backwards and upwards to its origin from the mastoid process. The junction of the external auditory meatus, the sternomastoid muscle, and the digastric muscle is the landmark for the main trunk of the facial nerve. A bone hook is placed on the angle of the jaw which is pulled forwards to increase the space behind the ascending ramus. A retractor holds the parotid gland forwards. The trunk of the facial nerve is identified by the separation of the blades of a fine curved haemostat. Close to it runs a small artery which may have to be ligated.

Division of external carotid division of the parotid gland

5 The stylo-hyoid muscle is identified above the digastric and retracted downwards. Emerging from above it in the anterior part of the wound is the external carotid artery as it enters the deep surface of the parotid gland. It is doubly ligated and divided. Above, the superficial temporal vessels are also doubly ligated and divided. By careful separation and division of the substance of the parotid gland with a fine curved haemostat and scissors, the two main divisions of the facial nerve and their terminal branches are identified, and the parotid gland split sagittally into a large superficial and a small deep part separated by the facial nerve. It is usually best to free the facial nerve branches starting from frontal and inferior mandibular branches and working towards the centre.



Preservation of terminal nerves

6 The dissection is continued, and the terminal branches of the facial nerve as they run on the masseter muscle are identified and preserved. Particular care is necessary to preserve the lowest (inferior mandibular) and the highest (frontal) branches The skin flap is then dissected up to the anterior edge of the parotid, and the superficial part of the parotid removed after ligature and division of the parotid duct.
At this stage the auriculo-temporal nerve may be identified as it runs with the superficial temporal artery and avulsed as a possible prophylaxis against post-operative gustatory sweating





Excision of remainder of gland and underlying muscle

7 A thin strip of latex rubber is placed under the facial nerve to raise the nerve and its branches away from the underlying muscle and deep part of the gland. The latter is freed deeply partly by blunt and partly by scissors dissection, and anteriorly from the masseter and jaw by knife dissection.



Ligation of internal maxillary artery and retrocondylar veins

8 The internal maxillary artery as it runs forward from the gland deep to the ascending ramus of the jaw is ligated and divided. Some retrocondylar veins in this area also need securing The deep portion of the gland is now free and is removed The wound is thoroughly irrigated with 1 in 1 000 perchloride of mercury solution as a prophylactic against implantation recurrence, and subsequently the mercury solution is washed away with saline

A free fat graft is removed from the subcutaneous tissue of the inguinal region and laid superficial to the facial nerve to fill up the hollow left by the removal of the parotid gland.

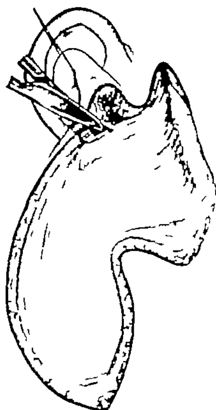


Closure

9 The wound is closed in its upper part by skin sutures only in its lower part in two layers, platysma and skin. Suction drainage is carried out through a fine polythene tube introduced through a stab wound.

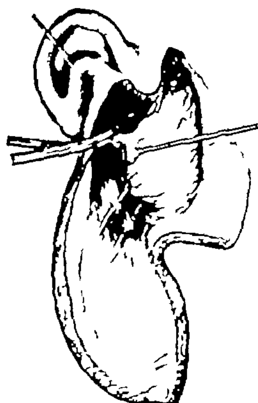
RADICAL PAROTIDECTOMY

The incision



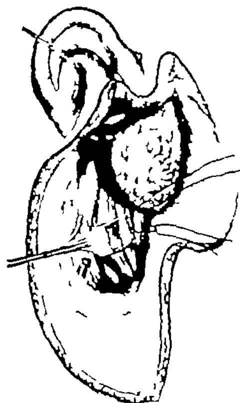
10 The incision is as in conservative parotidectomy The skin flap is, however dissected forwards to uncover the whole of the parotid area. If a block dissection of the neck is being performed at the same time the neck part of the parotid incision is adjusted accordingly For simplicity however the operation will be here described as if a block dissection of the neck were not being performed at the same time

The incision having been made and flaps reflected, the margins of the parotid are identified and freed. Posteriorly the gland is separated from the cartilaginous external auditory meatus relying chiefly on blunt-pointed curved scissors to establish a plane of cleavage.



Deepening of the dissection

11 Superiorly the superficial temporal vessels are doubly secured and divided. The parotid fascia is divided well back on the sternomastoid and dissected forwards with the overlapping parotid gland to expose the anterior border of the sternomastoid up to the mastoid process During this stage the great auricular nerve and the external jugular vein are divided. The dissection is deepened to expose the posterior belly of the digastric and the parotid gland retracted up from the muscle The facial nerve is identified as it enters the posterior aspect of the gland and divided.



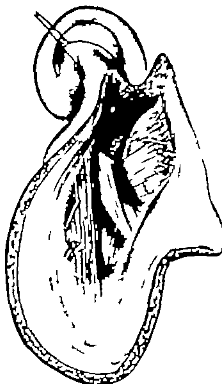
Ligation and division of the external carotid artery

12 The stylo-hyoid muscle is identified immediately above the digastric, and the external carotid artery exposed as it enters the deep inferior surface of the gland this artery is then doubly ligated and divided.



Excision of the gland

13 The anterior border of the gland is identified and the gland dissected back with the knife from the underlying masseter At this stage the anterior terminal branches of the facial nerve are cut, and also the parotid duct. The gland is gradually freed circumferentially so that it is only attached by its deep portion running between the mastoid and the ascending ramus of the jaw By a combination of blunt and scissors dissection, the gland is freed from its bed so that its only remaining attachment is the vascular pedicle running forwards deep to the ascending ramus. This consists of the internal maxillary artery and a retrocondyloid plexus of veins. These are ligated and divided and the gland is free.



Irrigation of the wound

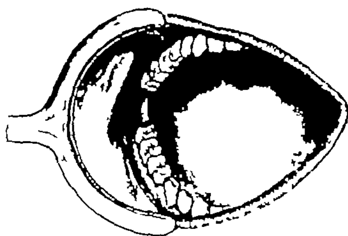
14 Irrigation of the wound with 1 1 000 perchloride of mercury may be valuable in killing any local cancer cells. The perchloride is washed away with saline. The closure of the wound, drainage and immediate post-operative care are similar to that following conservative parotidectomy except that special attention to the eye is indicated owing to the exposure from the facial paralysis.



ENLARGEMENT OF THE PAROTID DUCT ORIFICE

The approach

15 The mouth is kept open by a dental prop on the side opposite to that to be operated on. The angle of the cheek on the affected side is retracted.



The incision

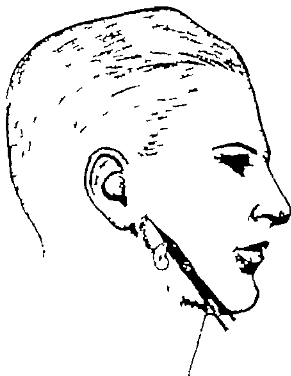
16 After preliminary dilatation of the duct orifice by lachrymal probes if necessary one blade of a fine-curved scissors is introduced into the duct which is cut for about ½–1 cm.



Approximation of the duct to the mucous membrane

17 Three fine silk stitches are used to approximate the duct to the mucous membrane of the cheek, one at the apex of the cut and one at each side.





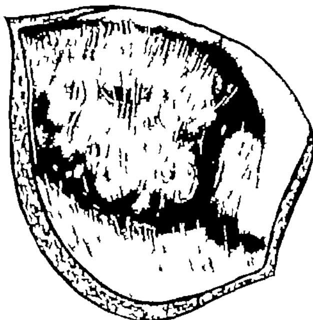
DRAINAGE OF PAROTID ABSCESS

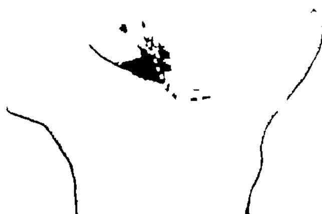
Incision through skin and subcutaneous tissue

18 In most cases there will be external evidence of the site of the abscess An incision is made over the abscess through the skin and subcutaneous tissue only preferably if possible in a direction corresponding to a normal skin crease.

Opening of the abscess cavity

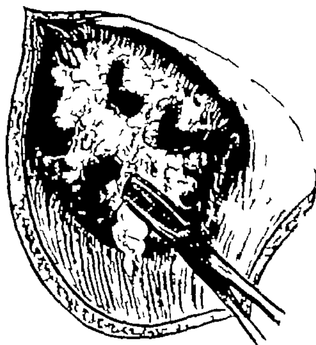
19 When the level of the parotid is reached the knife is discarded and the abscess opened by the insertion and separation of the blades of a blunt haemostat. The abscess cavity is drained by the introduction of soft latex rubber tubing





Wide exposure of the parotid gland

20 In severe cases with multiple abscesses and intervening necrosis of gland tissue (acute gangrenous parotitis) it may be advantageous to expose the parotid gland widely A long vertical incision is made in the skin crease immediately anterior to the ear down to the surface of the parotid gland, curving slightly forwards in the skin crease below the jaw



Forward reflection of skin and subcutaneous tissues

21 The skin and subcutaneous tissues are reflected forwards from the superficial surface of the parotid gland.

Abscesses are opened by insertion of a blunt haemostat as above, any separated necrotic glandular tissue removed, and the wound lightly packed with thin latex rubber tubing to keep the skin edges widely separated.

If the patient recovers, the final cosmetic result may be surprisingly good.

VARIANTS OF CONSERVATIVE PAROTIDECTOMY

Depending on the pathological lesion present and its exact site in the gland, a number of variants of the operation may be carried out, for example, partial parotidectomy (partial removal of the gland usually superficial to the facial nerve) superficial parotidectomy (removal of the whole of the gland superficial to the facial nerve, which since the nerve lies deeply in the gland implies the removal of the greater part of the gland—subtotal parotidectomy) and total parotidectomy as above described. The early stages of all these variants are the same.

SPECIAL POST-OPERATIVE CARE

Conservative parotidectomy

The drain is removed at 24 hours. The stitches are removed on the fourth or fifth day and an anti-keloid dose of x rays given. If there is no facial paralysis, no special treatment is indicated. If there is facial paralysis with some delay in recovery electrical stimulation of the facial muscles may be indicated. Recovery from the paralysis is usually rapid, and in any case can be relied on if the nerve and its branches have been preserved anatomically intact.

Radical parotidectomy

Operations may be performed to diminish the deformity and disability of the facial paralysis, for example, partial tarsorrhaphy for the eye and the introduction of fascial slings for the facial deformity generally

ACKNOWLEDGEMENT

The illustrations for the section Conservative Parotidectomy have been redrawn from originals which first appeared in the "Archives of the Middlesex Hospital" and appear by courtesy of Messrs. Livingstone Ltd.

[*The illustrations for the section on Conservative Parotidectomy were drawn by Miss Hewland the other illustrations were drawn by Mr F Price.*]

Bibliography

Patey D H. (1954). *Arch. Middx. Hosp* **4**, 91
Redon, H. (1955). *Chirurgie des Glandes Salivaires*. Paris.
Zymbal, W E. (1939) *Tumours of the Salivary Glands*. Leningrad.

INTRA-ORAL REMOVAL OF SUBMANDIBULAR DUCT CALCULUS

DAVID H PATEY M.S., F.R.C.S.

Surgeon Middlesex Hospital

PRE-OPERATIVE

Indications

Calculi in the anterior part of the duct showing no signs of passing spontaneously should be removed surgically No attempt should be made, however to remove intra-orally calculi in the posterior part of the duct, since these always lie much deeper than intra-oral palpation would suggest, and require excision of the gland.

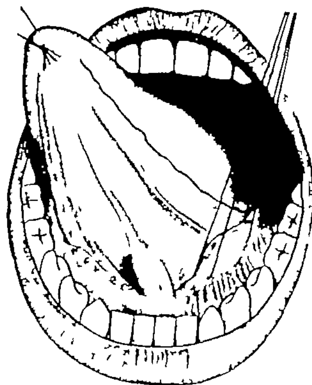
Even though the calculus is easily palpable intra-orally it is advisable to get x rays taken which include the neck in order to exclude the presence of intra-glandular calculi

Anaesthesia

Local anaesthesia may be used but general anaesthesia is much to be preferred. A nasal tube is passed and the fauces packed.

Position of patient

The patient is placed supine with the head well elevated.



THE OPERATION

Exposure and fixation of calculus

1 The mouth is kept open by a dental prop on the side opposite to the calculus A stitch is passed through the tip of the tongue which is retracted away from the side of the calculus. Two stitches are passed to pick up the tissues of the floor of the mouth, one in front of and one behind the calculus.



Excision of calculus

2 Using a pull on the stitches in the floor of the mouth to fix the calculus, a cut is made with a small bladed knife on to the calculus along its whole length until its grating is plainly felt. The calculus is removed with the knife itself or with a scoop or blunt dissector It is not necessary or desirable to suture the incision in the duct.

POST-OPERATIVE CARE AND COMPLICATIONS

No special post-operative care is required except frequent mouth washing

Stricture with obstruction of the duct sometimes results as a complication and requires treatment by excision of the gland.

[*The illustrations for this Chapter on Intra-oral Removal of Submandibular Duct Calculus were drawn by Mr F Price.*]

EXCISION OF SUBMANDIBULAR GLAND

DAVID H. PATEY M.S., F.R.C.S.

Surgeon Middlesex Hospital

PRE-OPERATIVE

Indications

The main indication is the presence of intraglandular calculi or calculi too far back in the submandibular duct to be removed from the mouth, associated with either chronic or intermittent swelling of the gland. Occasionally similar symptoms may be caused by and excision indicated for a stricture of the submandibular duct, as after operations on or irradiation treatment of the floor of the mouth and for chronic inflammation of the gland without calculus formation. As less common conditions, primary tumours of the gland (for example mixed tumours) cysts in or adjacent to the gland (for example dermoid cysts) and pathological conditions of the submandibular lymphatic glands (for example tuberculosis) may call for excision of the submandibular gland. This excision also forms part of the standard procedure of block dissection of the neck for malignant cervical glands. Finally the submandibular gland may sometimes be conveniently removed in order to allow greater freedom of dissection of pathological conditions of the floor of the mouth (ranula) by allowing free excision of the submandibular duct.

By far the commonest indication is, as already stated, salivary calculi. A preliminary x-ray examination is necessary in order to determine the number and position of the calculi, and it is after this that the final decision is made whether to remove the calculi by an intra-oral operation, or the submandibular gland by a neck operation. Unless the calculi are clearly confined to the anterior part of the duct, removal of the gland from the neck is indicated.

Anaesthesia

General anaesthesia and an intratracheal tube are advisable

Position of patient

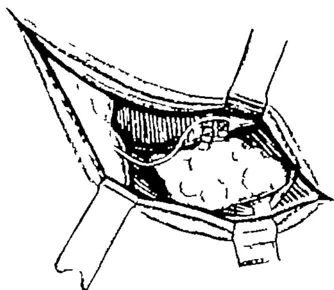
The patient is placed supine the head slightly extended and turned to the other side and the head end of the table is elevated.

THE OPERATION



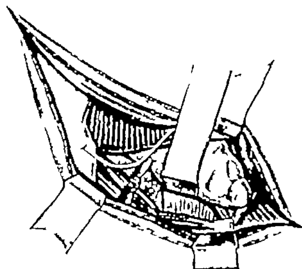
The incision

1 This is made accurately in the upper skin crease of the neck, and it is an advantage if this crease is marked out while the patient is still conscious. Preliminary subcutaneous infiltration of the area with a dilute solution of adrenaline ($\frac{1}{2}$ ml. of 1 in 1 000 adrenaline in 2 oz. of $\frac{1}{2}$ per cent procaine solution) is also helpful in diminishing bleeding



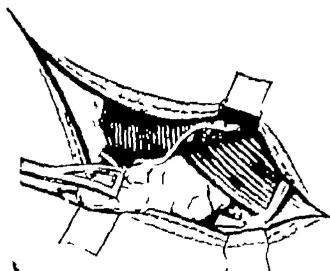
Identification of the facial vessels and nerve

2 Skin subcutaneous tissue and platysma are divided, and the upper flap including platysma dissected up to the level of the lower border of the jaw The facial artery and vein are identified as they emerge from the gland to cross the lower jaw but before these are divided *the cervical branch of the facial nerve is identified as it loops below the jaw at the level of the facial vessels* before running upwards towards the angle of the mouth, and gently pushed upwards away from the field of excision. This is a most important step of the operation and if omitted may result in a permanent ugly deformity of the angle of the mouth. The facial artery and vein are now doubly ligated and divided



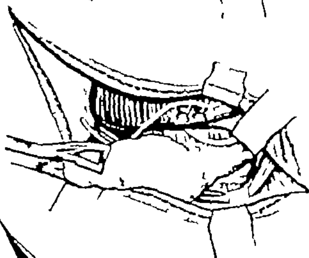
Freeing of lower portion of gland by dissection of the lower flap

3 The lower border of the gland is similarly freed, and the facial vein identified, doubly ligated, and divided as it emerges superficially from the gland. The lower border of the gland is now retracted upwards to expose the facial artery entering the deep surface of the gland, and this too is doubly ligated and divided.



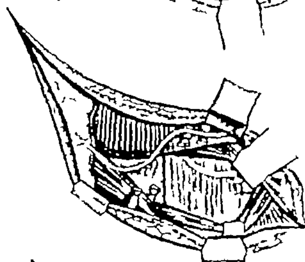
Freeing of the anterior portion of the gland

4 The gland is now freed anteriorly and dissected backwards from off the mylohyoid muscle until the posterior border of the muscle is exposed During this dissection small vessels are encountered running forwards from the tip of the gland, and these are secured



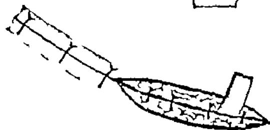
Freeing of the deep portion of the gland

5 The posterior border of the mylohyoid muscle is retracted forwards to expose the small deep portion of the gland lying on the hyoglossus muscle This deep portion is freed by sharp dissection from the lingual nerve above. The hypoglossal nerve may be seen below but is not as closely related to the gland as the lingual.



Division of the duct

6 The duct running forwards from the anterior border of the deep part of the gland together with some associated veins is doubly ligated and divided.



Closure

7 The platysma is sutured with fine interrupted plain catgut followed by suturing of the skin A narrow thin single layer of latex rubber is left between the stitches to allow escape of exudate Alternatively a polythene tube may be inserted through a stab incision and suction drainage adopted as after parotidectomy (*see* Part VI, page 140) The latex rubber or polythene tube is removed 24 hours after operation and the skin sutures on the fourth day It is recommended that a prophylactic anti-keloid dose of x-rays is then given to the scar

[*The illustrations for this Chapter on Excision of Submandibular Gland were drawn by Mr F Price*]

Reference

Martin, H., Del Valle, B., Ehrlich, H., and Cahan, W G. (1951). "Neck Dissection." Cancer 4, 441–499

INNOCENT TUMOURS OF THE TONGUE AND FLOOR OF MOUTH

RONALD W RAVEN O B E T D F R C S

Surgeon Westminster (Gordon) Hospital London Surgeon The Royal Marsden Hospital London

PRE-OPERATIVE

The pre-operative preparation is the same as for operations for malignant tumours of the lip For the anaesthesia used and method of application and also position of patient and arrangement of towelling the reader is referred to the Chapter on Epithelioma of the Lip (Part VI page 128)

THE OPERATIONS

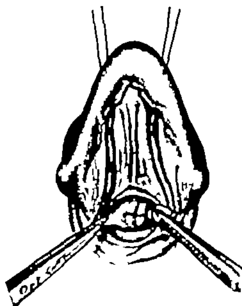
EXCISION OF SEQUESTRATION DERMOID CYST IN FLOOR OF MOUTH

PROTRUSION INTO THE MOUTH

Incision, reflection of flaps

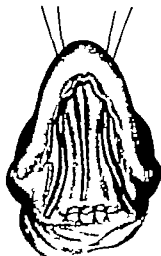
1 The mouth is held wide open by a Mason's gag and two stay sutures of nylon are passed through the dorsum of the anterior aspect of the tongue to hold the organ in full and upward protrusion. A curved horizontal incision is made over the lower part of the cyst through the mucous membrane of the floor of the mouth.

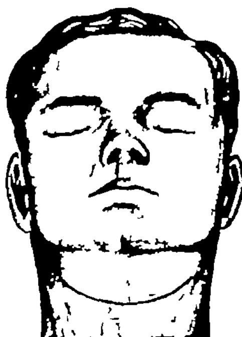
The upper and lower flaps of mucous membrane are dissected off to expose the capsule of the cyst which is then dissected out and removed. Haemostasis is secured.



Suture of flaps

2 The mucous membrane flaps are sutured in position with interrupted sutures of fine catgut. The wound is painted with Whitehead's varnish





PROTRUSION INTO THE SUBMENTAL REGION

The incision

3 A curved incision is made in the submental region commencing 2·5 cm below the angle of one mandible and extending to the same point below the other with its maximum convexity at the upper border of the hyoid bone.

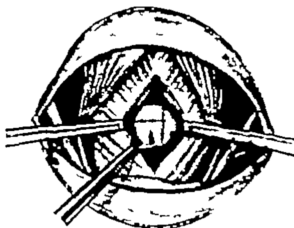
Reflection of skin flaps

The upper skin flap and subcutaneous tissue is reflected off the deep fascia as far as the symphysis menti and the horizontal rami of the mandibles. The lower flap is undermined for a distance of 1·5 cm.

Exposure and removal of the cyst

4 The cyst projects into the submandibular space and is exposed by dividing the median raphé of the mylo-hyoid muscles and by lateral retraction of the genio-hyoid muscles. The capsule is separated from the surrounding tissues and its attachment to the hyoid bone is divided. Haemostasis is secured, the genio-hyoid muscles are replaced in their normal position, and the mylo-hyoid muscles are approximated with interrupted sutures of catgut (No 0)

The skin flaps are sutured back in their normal position and the wound is closed with drainage.



TUBULO-DERMOID CYST IN THE POSTERIOR PART OF THE TONGUE

The cyst is removed by an intra-buccal approach. The mouth is held wide open by a Mason's gag and a stay suture of nylon is inserted through the anterior aspect of the dorsum of the tongue to hold it in full protrusion. The technique used varies with the type of cyst.

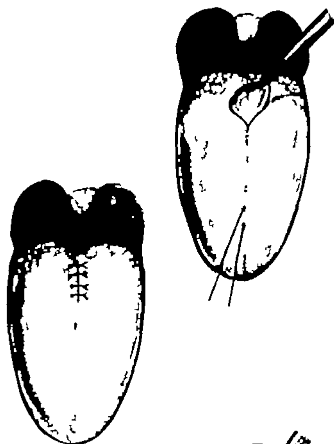
THE CYST IS SUPERFICIAL

The incision and enucleation of the cyst

5 An incision is made around the cyst through the mucous membrane of the tongue.
The cyst wall is separated from the surrounding tongue tissue and the cyst is removed.

Closure of the wound

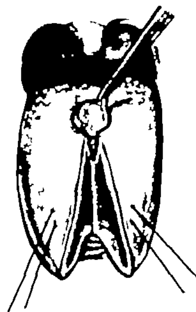
6 Haemostasis is secured, the wound is closed with interrupted sutures of fine catgut and Whitehead's varnish is applied.

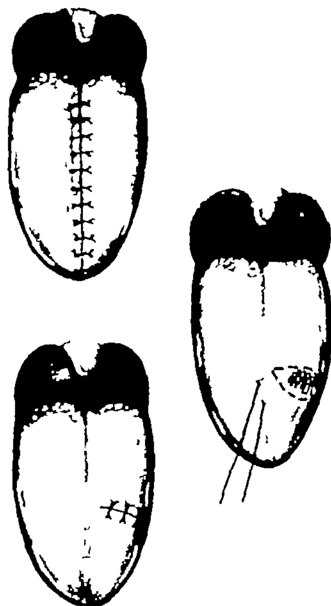


THE CYST IS DEEP IN THE TONGUE (MEDIAN TRANS-LINGUAL OPERATION)

The incision and enucleation of the cyst

7 The mouth is held wide open by a Mason's gag and two stay sutures of nylon are inserted through the dorsum of the tongue on each side of the midline to hold it in full protrusion.
The incision commences at the tip of the tongue and passes backwards along the median raphé separating its muscles in the midline. The two halves of the tongue are held apart by the stay sutures.
The median incision in the tongue is continued to the anterior aspect of the cyst wall. The cyst is then enucleated from its surroundings.





Reconstruction of the tongue

8 Haemostasis is secured and the two halves of the tongue are replaced in position and the incisions in the mucous membrane on the dorsal and ventral surfaces are sutured with interrupted sutures of fine catgut. Whitehead's varnish is applied to the wounds.

PAPILLOMA

The incision

9 The mouth is held wide open by a Mason's gag and a stay suture of nylon is passed through the dorsum of the anterior aspect of the tongue to hold the organ in full protrusion An elliptical incision is made through normal tissue to encircle the base of the tumour The incision is then deepened into the substance of the tongue so that the tumour is removed completely

Closure of the wound

10 Haemostasis is secured and the wound is sutured with interrupted sutures of fine catgut. The incision is painted with Whitehead's varnish.

PEDUNCULATED LIPOMA

The incision excision closure

The incision is made through the mucous membrane to encircle the base of the pedicle The remainder of the pedicle is excised and haemostasis is secured. The edges are sutured with interrupted sutures of fine catgut. The wound is painted with Whitehead's varnish.

SESSILE LIPOMA AND FIBROMA

The incision, excision closure

The mucous membrane is divided over the tumour and its capsule is exposed. The tumour with its capsule is shelled out from the surrounding tissue. Haemostasis is secured and the edges of the wound are sutured with interrupted sutures of fine catgut.

CAVERNOUS HAEMANGIOMA AND LYMPHANGIOMA

An identical technique as above is employed for the removal of other innocent tumours, such as cavernous haemangioma and lymphangioma. A capillary haemangioma should be coagulated with the diathermy needle

DENTAL CYSTS AND TUMOURS

B W Fickling, F.R.C.S., F.D.S. (Eng.)

Senior Dental Surgeon St George's Hospital London Dental Surgeon Royal Dental Hospital of London School of Dental Surgery Senior Dental Surgeon The Mount Vernon Centre for Plastic and Jaw Surgery Northwood

INTRODUCTORY

The mouth is the site of a wide variety of tumours, both ectodermal and mesodermal of hard and soft tissues, together with a special group of tumours of odontogenetic origin. In addition various dysplasias of bone occur in the jaws

In spite of the multiplicity of tumours encountered it is possible to classify the operative treatment into the following broad categories.

Simple excision of peripheral tumours.

Enucleation of encapsulated central tumours, with or without closure.

Marsupialization of various cystic cavities.

Subperiosteal excisions of locally invasive tumours.

Radical excision of generally malignant tumours. The last named is not described in this Chapter

Special investigations

Radiographs are essential in differential diagnosis and treatment planning Dental films give accurate information on tooth involvement or loss of the fine *lamina dura* of bone around the tooth indicating the need for extraction. Occlusal films are specially valuable in the front of the mouth. Rotated lateral views of the jaws are required to show the extent of larger tumours and provide clear pictures of the angle and ramus of the mandible. Lateral skull and films of the long bones may be required to exclude general bone disease

Aspiration may be required to prove whether a tumour is solid or cystic and to differentiate between cysts and the maxillary sinus. This may be followed by the injection of a radio-opaque fluid and radiography to show the extent of the cavity and its communications

Biochemical investigations are indicated when hyperparathyroidism or Paget's disease is suspected. The latter gives a higher serum alkaline phosphatase reading than is found in many bone diseases, while a high serum calcium and low inorganic phosphate is indicative of parathyroid tumour

Biopsy is required for all larger tumours where a malignant change is suspected and where the diagnosis is in doubt. Many smaller peripheral tumours are better excised without biopsy the complete specimen then being sectioned. When the clinical and radiographic evidence strongly suggests a cyst, biopsy is avoided as resulting in infection of the cavity prior to operation

Attention to oral hygiene

Before any operative procedure in the mouth it should be rendered as clean as possible by scaling and polishing of the teeth. Grossly carious teeth and roots should be extracted. For convenience this is often performed under the same anaesthetic.

Anaesthesia

Local or regional anaesthesia is satisfactory for all smaller tumours, mild sedation with aspirin or a barbiturate being valuable. For nervous individuals and for all the more extensive operations general anaesthesia with an endotracheal tube and throat pack is preferable.

SIMPLE EXCISION OF PERIPHERAL TUMOURS

The pedunculated fibroma and osteoclastoma respectively designated fibrous and myeloid epulis are most common Sessile forms are seen together with papillomas, haemangiomas, and pregnancy tumour All other tumours are rare

Indications

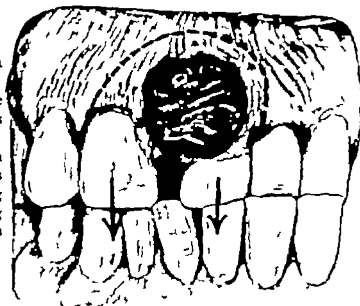
It is preferable to remove all peripheral tumours in the mouth. Trauma, haemorrhage and ulceration readily occur while increase in size leads to involvement of more teeth and greater deformity of the alveolus after removal.

Involvement of teeth

To prevent recurrence it is necessary to remove the base of the tumour which owing to the nature and close attachment of the mucoperiosteum, frequently means a small area of bone When the tumour is adjacent to a tooth, it follows that some of the support of the tooth is removed and the root bared. It is therefore usually necessary to extract the tooth adjacent to the pedicle which may be attached to the periodontal membrane If it is desired to be conservative and retain the tooth, the base may be treated with the electric cautery and watch kept for recurrence

THE OPERATION

1 Incisions are made approximately one-tenth of an inch from the periphery of the tumour which is excised together with the bone In the normal site on the alveolus, the incision is down to bone, and a small area of the bony base should be excised together with the teeth on either side of the tumour The gum is approximated with sutures if possible, failing which a small gauze pack incorporating paraffin and flavine emulsion or Whitehead's varnish is sutured over the raw surface.



ENUCLEATION OF ENCAPSULATED CENTRAL TUMOURS

The dental cyst is the common form, the dentigerous cyst being similar only containing the crown of a tooth. The following special points apply to these simple cysts.

(1) When small, the ideal is enucleation and closure by suture.

(2) The cavity must never be closed or allowed to close over unless it is *certain* that all lining has been removed.

(3) When over 2–3 cm. in diameter the cavity is too large for primary healing when closed, infection and breakdown supervening. The cavity must therefore be left open.

(4) The *lining* must be *removed* whenever it shows hyperplasia or papilliform changes (adamantinomatous change). In this case the cavity is packed.

(5) The *lining* should be *left* when in close approximation with the maxillary sinus, nasal floor or mandibular nerve. In this case the cavity may be saucerized and packed, or a more narrow entrance constructed and maintained by a plastic plug attached to a denture until the cavity has regressed in size (9–24 months—Partsch technique, page 160)

(6) The lining in most dental and dentigerous cysts is a squamous epithelium modified by pressure and sometimes by infection. If removed, a painful bone surface is laid bare which is slowly re-covered by a similar epithelium.

(7) Dental cysts increase in size due to hydrostatic and osmotic pressure. When an efficient opening into the cyst is maintained, the cavity slowly fills in from the periphery until the normal contour is approximately restored.

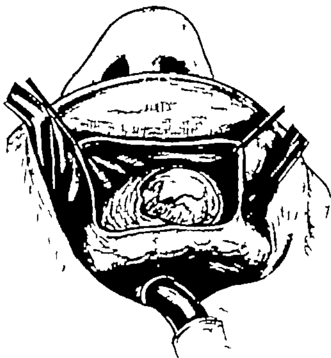
(8) Teeth with roots involved in the cyst should be extracted.

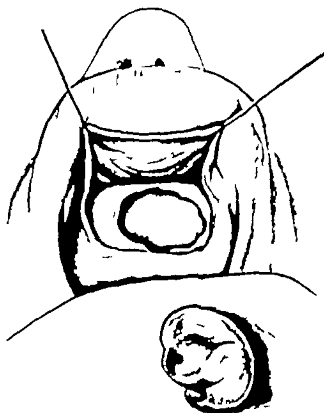
(9) A standard radical operation of extractions, extensive bone removal and curettage leads to pain, permanent denture disability, antral fistula and, especially in the ramus, recurrence.

THE OPERATION

Exposure

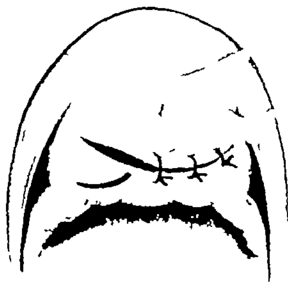
1 A straight or slightly curved incision is planned so as to cut down to bone rather than across a fluctuant area. It should extend on to normal bone at each end. The incision will run along the gum pocket of any teeth to be extracted. The mucoperiosteum is elevated to expose the bone, through which the fibrous cyst wall often presents. The tumour is exposed by removal of covering bone, first with a small chisel and then with bone-nibbling forceps.





Enucleation

2 When adequately exposed the tumour is enucleated with curved flat dissectors. Any necessary teeth are extracted and the bone edges made smooth



Closure

3 The incision is closed with sutures of black silk, catgut being unsuitable in the mouth. Irregular gum tags are first trimmed if teeth have been removed.

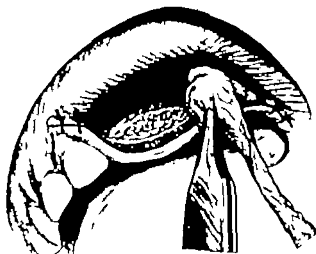
MARSUPIALIZATION OF THE LARGER CYSTIC CAVITIES

SAUCERIZATION

1 Saucerization is particularly suitable for the convex anterior portion of the maxilla and mandible.

The cyst is exposed as in Illustration 1 (page 168) the incision again following the alveolar ridge. Rather more of the outer bony wall is removed, avoiding the distal wedge of bone which might expose the maxillary sinus. Teeth are extracted if necessary. The cyst is opened, the outer wall removed and kept for section, and the lining inspected. In most cases it is left *in situ*. When indicated it is carefully removed to avoid fistula formation or other trauma.

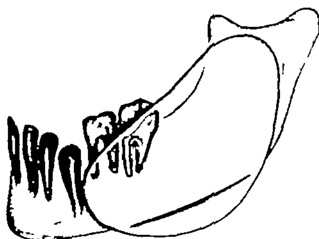
The extremities of the incision are closed with sutures. The labial mucoperiosteal flap is turned in to cover the raw surface, being trimmed to meet the lining when this remains, and is maintained with a ribbon gauze pack *incorporating paraffin and flavine emulsion* or a similar dressing



THE PARSTCH TECHNIQUE

Marsupialization employing a relatively narrow opening

1 The Parstch technique is specially applicable to large cysts in the tuberosity of the maxilla and the ramus of the mandible, where saucerization is anatomically impossible and enucleation often incomplete and followed by complications. The illustration shows diagrammatically a representation of a lateral radiograph of the mandible containing a large cyst. The cyst is exposed from within the mouth as in the previous operation, an opening at least 2 centimetres in diameter being desirable. Any contained and involved teeth are extracted, and a portion of lining kept for section. A dental impression for the construction of an acrylic obturator is obtained. The opening is then packed with ribbon gauze incorporating an emollient and bacteriostatic.

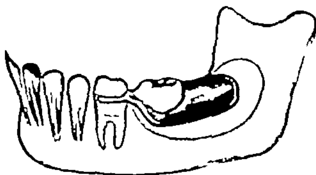




2

Insertion of obturator

In 2–4 days the gauze pack is removed and the dental obturator inserted. It must be worn continuously for active fibrous constriction of the orifice persists for some months.

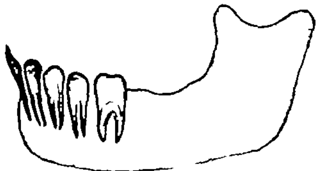


3

Shortening of obturator with restoration of bony contour

The cyst cavity being kept permanently open there is no cyst pressure and regression gradually occurs, bone deposition following. The cyst obturator is shortened when it is impinging on the tissues.

After 12–36 months the bony contour is restored to normal. When repair is delayed there may be indications for a secondary enucleation, the bony walls being thicker and stronger and the possibility of complications reduced.



SUBPERIOSTEAL EXCISION OF LOCALLY INVASIVE TUMOURS AND DYSPLASIAS, WITH REPAIR

Indications

Adamantinoma and osteoclastoma are typically treated in this manner Excision may also be indicated for certain cases of fibrous dysplasia when advancing rapidly

Fixation of fragments

The remaining portions of the mandible are maintained in correct position by dental cap splints cemented to the teeth of both jaws before operation. The common site for adamantinoma is the angle of the mandible and resection leaves an unsupported posterior ramus fragment. This should be maintained in its pre-operative position by pin fixation. When there are no teeth on the main fragment other maxillo-facial principles are applied.

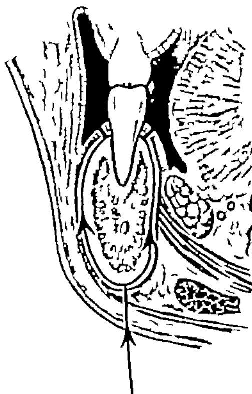
Planned repair by bone graft

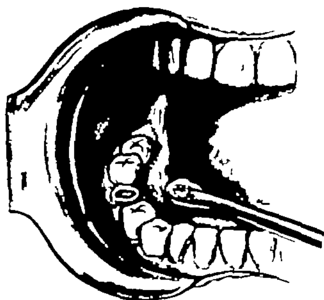
Radical surgery for these benign tumours is only rational if successful repair can be completed. Dental splinting and repair by autogenous bone graft is a pre-requisite of the treatment, bone being preferable to inert substitutes. During resection the external wound usually becomes compound into the mouth, and the bone graft is best delayed 3–4 weeks or until the mouth wound has healed. The dental splinting is maintained throughout this period and until the bone graft has consolidated.

THE OPERATION

The plane of dissection

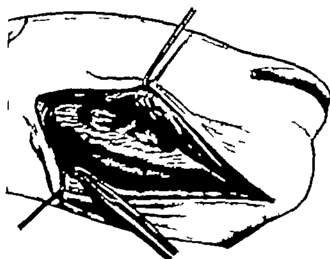
1 The incision is slightly internal to the subcutaneous inferior border of the mandible. The bone is removed subperiosteally but very thin cysts may necessitate a wider dissection. An intra-oral incision is required around any teeth standing in the area to be resected.





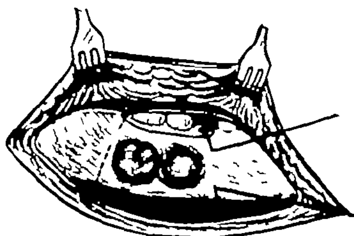
The intra-oral incision

2 When there is no gap in the dental arch a tooth must be extracted beyond the margin of the tumour An incision is made through the socket and around the teeth to be removed with the tumour



The submandibular incision

3 This incision usually crosses the facial vessels lying deep to the platysma just in front of the masseteric insertion. The vessels must be exposed, clipped, divided and tied The periosteum is incised along the inferior border. and stripped from the external and internal surfaces of the bone with a rugine. Care is required to make a clean dissection of the mylo-hyoid ridge without tearing the tissues in the floor of the mouth



Section of the bone

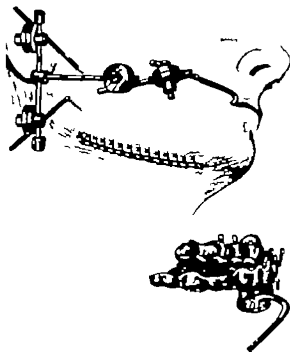
4 When the segment of jaw has been fully exposed, a Gigli saw is passed around the lingual aspect. During the use of the saw the soft tissues are retracted and protected from trauma and the line of section irrigated with normal saline. The arc of the saw should be as straight as possible (it is much too angulated in the illustration)

Immobilization of fragments and closure of wounds

5 The intra-oral incision is carefully closed with mattress sutures. Pins of Roger-Anderson type are inserted into the posterior fragment close to the posterior border The anterior main fragment is immobilized to the upper jaw with dental cap splints in correct dental occlusion. The pins on the posterior fragment are joined to an extension from the splints by bars and universal joints incorporating an insulating sleeve to prevent electrolytic action, and adjusted to correct contours.

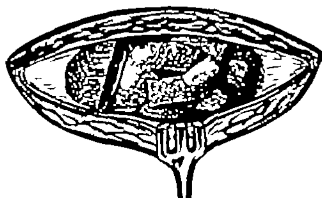
The incised periosteum is sutured with catgut which is also used to approximate the subcutaneous tissues to avoid dead spaces. The skin is closed with interrupted black silk sutures.

Fixation of the posterior fragment at this stage is not essential, but it is more easy to maintain than to recreate correct contour and the complications associated with gross forward displacement are avoided.



Insertion of bone graft

6 After 8 weeks, or when the oral incision is soundly healed, the submandibular incision is reopened, *and the periosteal plane and bone* ends defined. The bone ends are slightly stepped to provide a broader surface of bleeding cancellous bone. Chips of cancellous bone from the iliac crest are inserted according to the technique described by Mowlem (1944)



Closure of tissues over bone graft

7 The periosteum and platysmal layer is approximated over the chips with interrupted catgut sutures and the skin incision is closed with silk sutures as before.



[*The illustrations for this Chapter on Dental Cysts and Tumours were drawn by Mr R. N Lane*]

Reference

Mowlem, R. (1944) *Lancet*, **2**, 740

PART VII

VASCULAR SURGERY

PART VII VASCULAR SURGERY

Section I: Sympathetic Nervous System Page

Sympathetic ganglion block 5

Upper thoracic sympathetic ganglionectomy 8

Lumbodorsal sympathectomy and splanchnicectomy; presacral neurectomy 20

Lumbar sympathetic ganglionectomy 28

Section II Veins

Varicose veins 35
- ROUTINE STRIPPING
- RE-LIGATION

Ligation of the ankle-perforating veins 47

Gravitational ulcers 51

Phlebography 54
- ASCENDING PHLEBOGRAPHY
- DESCENDING PHLEBOGRAPHY

Deep vein ligation 57

Inferior vena cava ligation 61

Section III Arteries

Exposure or ligation of major blood vessels 64
- EXPOSURE OF INNOMINATE ARTERY AND FIRST PART OF SUBCLAVIAN
- EXPOSURE OF THIRD PART OF SUBCLAVIAN
- EXPOSURE OF AXILLARY ARTERY
- EXPOSURE OF BRACHIAL ARTERY IN THE ARM
- EXPOSURE OF BRACHIAL ARTERY AT ITS BIFURCATION
- EXPOSURE OF COMMON CAROTID ARTERY
- EXPOSURE OF INTERNAL AND EXTERNAL CAROTID ARTERIES
- EXPOSURE OF ABDOMINAL AORTA
- EXPOSURE OF COMMON ILIAC ARTERY
- EXPOSURE OF EXTERNAL ILIAC ARTERY
- EXPOSURE OF COMMON FEMORAL ARTERY
- EXPOSURE OF SUPERFICIAL FEMORAL IN HUNTER'S CANAL
- EXPOSURE OF POPLITEAL ARTERY
- EXPOSURE OF POSTERIOR TIBIAL ARTERY

Page

Arterial suture 81
- LATERAL SUTURE
- END-TO-END ANASTOMOSIS
- EVERTING MATTRESS SUTURE
- BLALOCK SUTURE
- SUTURE OF DISEASED ARTERY

Embolectomy 88

Artery or vein graft 93

Arteriography 101
- CAROTID ARTERIOGRAPHY
- VERTEBRAL ANGIOGRAPHY
- FEMORAL ARTERIOGRAPHY

Aortography 109

Congenital arterio-venous fistulas 111

Treatment of arterial aneurysms 115

Arterio-venous fistulas 127

Thrombo-endarterectomy 133

Section IV Operations for Lymphoedema

Excision of subcutaneous tissues for lymphoedema 138

Section V Other Procedures

Achilles tenotomy 142

For Operations on the Great Vessels *see* Part V THORAX

SYMPATHETIC GANGLION BLOCK

CHARLES ROB M C., M.CHIR., F R.C.S
Professor of Surgery St Mary's Hospital London
and
E. G TUCKWELL, M CH., F R.C.S.
Surgeon St Bartholomew's Hospital London Dean St Bartholomew's Hospital and St Bartholomew's Hospital Medical School London

PRE-OPERATIVE

Principles

The sympathetic ganglia may be temporarily blocked by the injection of procaine or another anaesthetic agent or semi-permanently blocked with phenol or alcohol The injection may be made at a number of sites, of which the most usual are the stellate (inferior cervical) ganglion, the upper thoracic ganglia, the splanchnic nerves and adjacent ganglia, and the lumbar ganglia

Indications

These are similar to those listed for the appropriate sympathectomy The most usual reason for a sympathetic block is to estimate the benefit which is likely to result from a surgical sympathectomy but there are a number of additional reasons for performing a sympathetic block these include elderly or bad-risk patients when a phenol block may be employed as an alternative to sympathectomy (Haxton, 1949) patients with angina decubitus when relief of pain may be obtained by blocking the upper five thoracic ganglia (Brunn and Mandl 1924) as a curative measure in patients with vascular spasm of probable short duration such as may occur due to an arterial embolus or a thrombophlebitis, and to assist the development of the collateral circulation after the ligation of a large artery

Premedication

The injection of morphine ¼ gr or pethidine 100 mg is useful as a sedative and should be given about 1 hour before the procedure. If the patient is still restless a further injection, this time intravenously of morphine or pethidine provides adequate sedation.

Apparatus

Thin lumbar puncture needles, or long No 22 gauge needles preferably graduated in centimetres, are satisfactory for the main injection.

Position of patient

Stellate or inferior ganglion block

The route may be anterior or posterior the former is the better The patient lies flat on his back with his arms by his sides and the head in line with the trunk.

Upper thoracic ganglion block

The patient is placed on his side with the head, hips and knees flexed as for a lumbar puncture, the head being supported on a pillow so that the spine is in a straight line.

Lumbar ganglion block

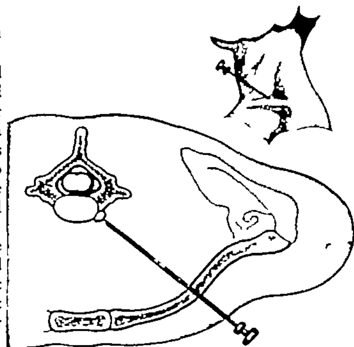
The patient lies face downwards with a pillow beneath the abdomen to reduce the lumbar lordosis.

Posterior splanchnic block

The patient is placed in a semi-prone position with the side to be injected turned upwards.

THE OPERATION

Stellate or inferior cervical ganglion block



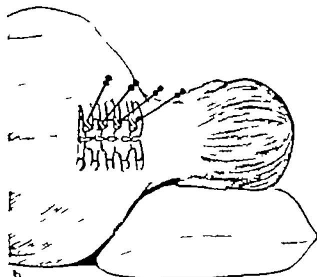
1 The mid-point of the clavicle is marked and the skin and deeper structures above and medial to this point anaesthetized with 0 5 per cent procaine. A lumbar puncture needle or a No 22 gauge needle at least 8 cm. long is then introduced at an angle of 45 degrees to the sagittal plane towards the body of the seventh cervical vertebra and advanced until the point strikes this bone.

A syringe is applied and aspirated to ensure that the needle is not in either the subarachnoid space or a blood vessel 10 ml. of 0 5 per cent procaine are injected. It is unwise to attempt the injection of this ganglion with alcohol or phenol.

Upper thoracic ganglion block

2 The spines of the upper four thoracic vertebrae are located and the injections made in line with these 4 cm from the midline. After infiltration of the skin and deeper structures with 0 5 per cent procaine, 10 cm. long lumbar puncture needles are introduced at right angles to the skin until the point strikes the transverse process. Each needle is manipulated until it lies at the lower edge of this bone. It is now angled to about 20 degrees to the sagittal plane and advanced until the point strikes the body of the vertebra.

The sympathetic chain lies at an average depth of 8 cm. from the transverse process against the side of the vertebral body If possible the needle should be marked in centimetres so that it can be placed in this position after these two bony points have been located by the needle point.

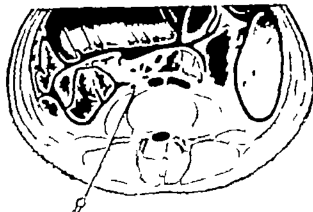


If aspiration produces neither blood, cerebro-spinal fluid nor air then the injection can be made for a diagnostic block 5 ml. of 0 5 per cent procaine are injected into each of the upper four thoracic ganglia. If an alcohol or phenol block is contemplated only 2 ml. of procaine are injected and if this produces a satisfactory block without complications 5 ml. of 95 per cent alcohol or 5 ml. of 10 per cent phenol in water are injected into each ganglion.

Lumbar ganglion block

3 The injection is made 8 cm from the midline at a level halfway between the second and third spinous processes. After infiltration of the skin and deeper structures with 0.5 per cent procaine a 10 cm lumbar puncture needle is inserted and advanced until it strikes the transverse process of the appropriate lumbar vertebra. It is then manipulated until it passes just above or below this bone

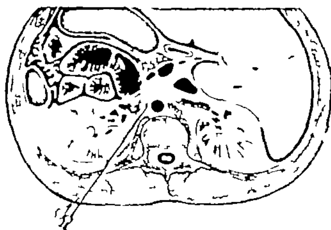
It is now angled so that the point is directed *medially towards the body of the vertebra* As soon as it strikes this bone it is carefully aspirated and if neither blood nor cerebro-spinal fluid is withdrawn the injection is made 80 ml of 0.5 per cent procaine for a temporary block, 10 ml. of 10 per cent phenol in water for a semi-permanent denervation



Posterior splanchnic block

4 This procedure will induce a block of the coeliac plexus in front of the first lumbar vertebra which in turn will affect the visceral autonomic nerve fibres in the coeliac ganglia. The injection is made four fingers breadth from the midline at the level of the first lumbar spine, or four fingers breadth from the midline immediately below the twelfth rib.

A 12 cm. short bevelled needle is inserted at an angle of 70 degrees through the erector spinae to strike the body of the first lumbar vertebra. The needle is withdrawn for 8 cm and redirected forwards—at about 80 degrees —passing the vertebra and into the retro-peritoneal space. Aspiration will confirm that the needle is not in a blood vessel or the subarachnoid space and then about 40 ml. of a 0.5 per cent procaine solution are injected and will anaesthetize both sides from one injection.



[Illustrations 1 and 2 for this Chapter on Sympathetic Ganglion Block were drawn by Mr R. N Lane and Illustrations 3 and 4 by Miss June Alister]

Bibliography

Braun, F., and Mandl, F (1924) *Wien Klin Wschr.*, 37 511
Haxton, H. A. (1949) *Brit. med J.*, 1, 1026.
Labat, G. (1930) *Regional Anaesthesia.* Philadelphia Saunders.

UPPER THORACIC SYMPATHETIC GANGLIONECTOMY

CHARLES ROB *M.C.*, M.CHIR., F.R.C.S.
Professor of Surgery St. Mary's Hospital, London
and
E. G TUCKWELL, M.CH., F.R.C.S
Surgeon St. Bartholomew's Hospital, London Dean St Bartholomew's Hospital, and St Bartholomew's Hospital Medical School London

PRE-OPERATIVE

Removal of the lower portion of the stellate or inferior cervical ganglion and the second and third thoracic ganglia produces a sympathetic denervation of the whole upper limb and most of the axilla (provided the rami communicantes from the first thoracic nerve to the stellate ganglion are left intact a Horner's syndrome does not develop) This operation also denervates to an undetermined extent the thoracic viscera. Removal of the fourth and fifth thoracic ganglia completes the denervation of the axilla, a wise addition if the operation is for hyperidrosis, and removal of the whole of the stellate ganglion denervates the head and neck with the production of a Horner's syndrome, an abnormality which is avoided by the standard operation.

This portion of the sympathetic chain may be approached by one of three routes—the cervical, axillary or posterior The cervical is the best because it causes the patient less inconvenience than either of the others but from the surgeon's point of view it is the most difficult. The axillary route is to be preferred when the ganglionectomy should be taken below the level of the third thoracic ganglion.

In the past there has been some argument as to whether a preganglionic or a postganglionic section or a ganglionectomy should be performed. Modern surgical thought was well summarized by Kinmonth and Hadfield (1952) when they stated that in the treatment of Raynaud's phenomenon the results of each of these methods were similar Ganglionectomy has the advantage that it is more likely to result in a complete denervation.

Regeneration

We agree with Lee MacGregor (1956) that this does occur but a more frequent cause of relapse or recurrence is an incomplete primary operation.

Indications

The following are some of the diseases for which this operation may be advised when the disability is sufficiently severe and medical measures have failed hyperidrosis, acrocyanosis, erythrocyanosis, primary Raynaud's phenomenon, secondary Raynaud's phenomenon (provided the cause is also treated) arterial occlusion (atherosclerosis thrombo-angiitis obliterans, arterial injuries and embolism) causalgia and sometimes painful phantom limbs, erythromelalgia, and reflex arterial spasm. When there is doubt as to the value of the procedure in a particular patient a diagnostic ganglion block (*see* pages 5–7) is the best single method of reaching a correct conclusion

Position of the patient

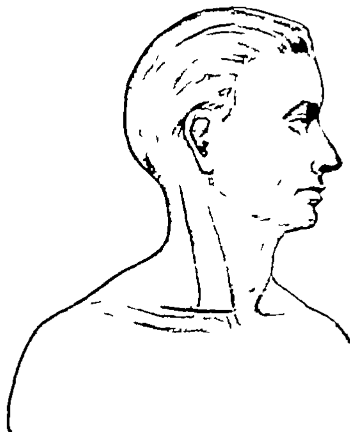
For the cervical operation the patient is placed flat on his back with the operating table tilted so that the head is raised sufficiently to prevent venous engorgement. The axillary operation is performed with the shoulder abducted and elbow flexed both to a right angle The posterior operation is performed with the patient prone on his face and with a pillow beneath the centre of the chest so that the shoulders fall forward.

THE OPERATIONS

CERVICAL APPROACH

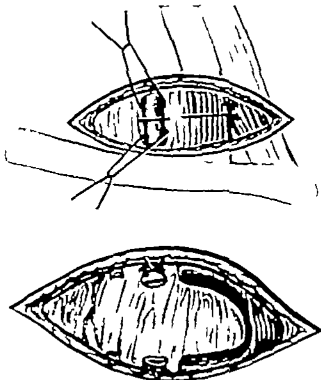
The Incision

1 The patient's head is first rotated to the opposite side and the arms placed by the side of the body. The incision is then made in line with the skin folds of the neck about half an inch above the inner third of the clavicle. The incision is about 8 inches long and is carried down through the platysma muscle when skin towels may be placed in position



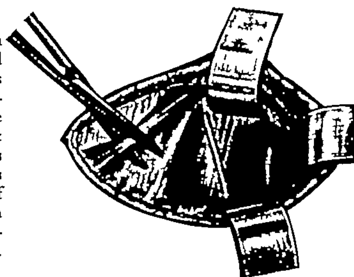
Partial division or retraction of the sternomastoid muscle

2 The external jugular vein is divided between ligatures and as few as possible of the supraclavicular cutaneous nerves. The sternomastoid muscle is now exposed and its outer border defined. This muscle may now be retracted medially but in our view it is better to divide the whole of the clavicular head of the sternomastoid muscle because the exposure is more satisfactory and, provided it is sutured at the conclusion of the operation, little disability follows even a bilateral operation.



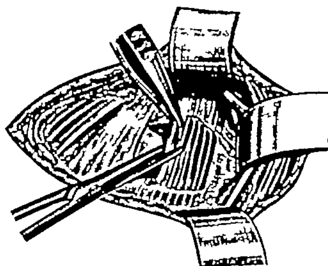
Exposure of the scalenus anterior muscle

3 The dissection is now carried down through a layer of fibro-fatty tissue The surgeon will encounter the omohyoid muscle, which is divided, and a number of small vessels. Retractors are placed at the inner end of the wound to expose the deeper tissues and protect the internal jugular vein. The dissection is deepened until the scalenus anterior muscle is found this is identified by the presence of the phrenic nerve lying deep to the fascia which crosses this muscle. This nerve is retracted medially with the internal jugular vein.



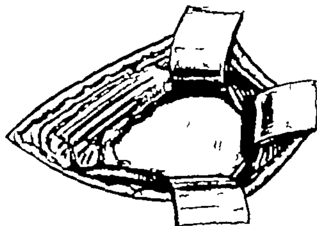
Division of the scalenus anterior muscle

4 This is the key to the operation. The muscle is clearly defined for a distance of about 1 inch, its outer anterior and medial borders being identified. It is then carefully divided a few fibres at a time by picking them up with dissecting forceps and cutting them with scissors. This method avoids damage to the surrounding structures which may follow a dissection completely round this muscle before division.



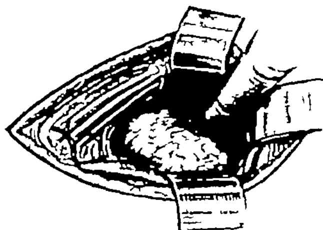
Exposure of the brachial plexus, subclavian artery and the dome of the pleura

5 Careful dissection will now locate the lower margin of the brachial plexus this need only be identified. The subclavian artery is next exposed and retracted downwards. In many patients it is unnecessary to divide any of its branches, but in others the costocervical artery and sometimes one or two small vessels which leave the upper side of the subclavian artery in this region may need division to complete the exposure of the dome of the pleura as it lies beneath the suprapleural membrane (Sibson's fascia) Some surgeons prefer to retract the subclavian artery upwards.



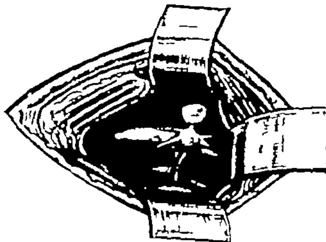
Mobilization of the pleura

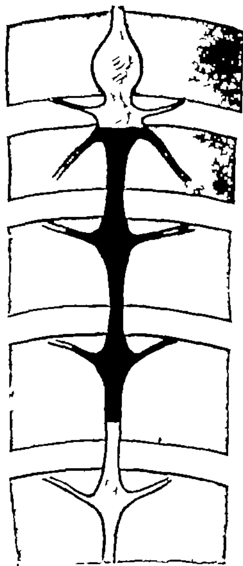
6 This is best carried out with the finger The suprapleural membrane is divided on the inner side of the triangle bounded by the brachial plexus, subclavian artery and internal jugular vein, and a finger introduced so that the pleura may be pushed downwards, forwards and outwards The pleura is stripped from the side of the vertebral column and posterior portions of the ribs to the level of the fourth rib and held down with a deep retractor which is preferably illuminated. Opening the pleura adds to the difficulty of the operation and for this reason should be avoided if possible



Identification of the sympathetic chain

7 The sympathetic chain is most easily identified by palpation. Sympathetic nerves are easily felt as thick cords and the ganglia as enlargements of this cord. After identification of the sympathetic chain by palpation the lower portion of the stellate ganglion is dissected free and its identity confirmed visually Gentle dissection with a small gauze will expose the second and third ganglia as they lie on the heads or necks of the appropriate ribs.



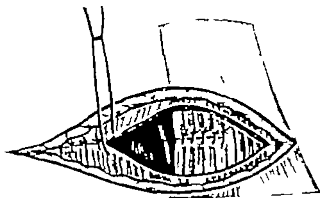


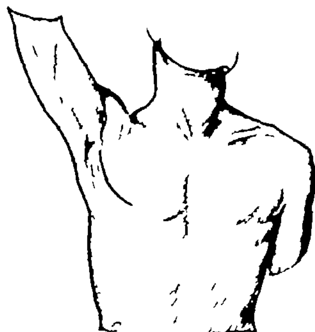
The sympathectomy

8 The sympathetic chain between the stellate and second thoracic ganglia is picked up with a nerve hook. The stellate ganglion consists of a large upper portion and a smaller lower portion which is in fact the first thoracic ganglion. This lower portion receives the rami communicantes from the first thoracic nerve. The ganglion is cut across below the point where these join it and the second and third ganglia freed. The sympathetic chain is then divided below the third ganglion and this segment removed. Great care should be taken during this portion of the dissection to avoid injury to the numerous veins which lie near to the sympathetic chain. Should bleeding start firm pressure should be applied for five minutes with a small swab over a long holder and the bleeding point then sealed with a Cushing Mackenzie haemostatic clip

Closure

9 The anaesthetist inflates the lung filling the wound with the pleura if this is intact. If the pleura has been opened it is not closed but the lung must be fully inflated and held so until the skin has been completely sutured. The divided portion of the sternomastoid muscle is united and the platysma layer sutured with fine catgut. The scalenus anterior and omohyoid muscles are not united.



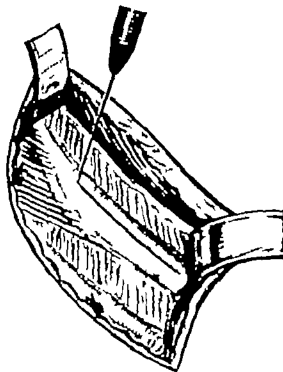


AXILLARY APPROACH

This is a transpleural operation and is therefore contra-indicated if there is any evidence that the patient has many adhesions between the visceral and parietal pleura in the region of the apex of the lung

The incision

10 The incision is made in the axilla and follows the line of the third rib It passes downwards and forwards across the medial wall of the axilla from the posterior to the anterior axillary fold and is usually about 6 inches long In women the incision should stop at least 1 inch before the anterior axillary fold is reached because a major reason for using this approach is the production of a less obvious scar

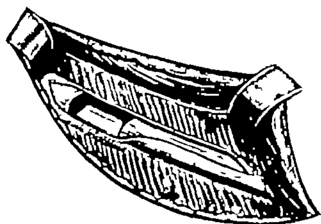


Exposure of the third rib

11 After the attachment of skin towels the incision is taken down to the periosteum of the third rib The pectoral muscles and breast are retracted well forward and the latissimus dorsi, teres major and subscapularis muscles backwards. The long thoracic nerve is identified and placed under the posterior retractor The lateral thoracic artery usually appears in the posterior portion of the wound and requires division. The third rib is exposed by incising the overlying fibro-fatty tissue of the axilla and removing the serratus anterior from its attachment to this base.

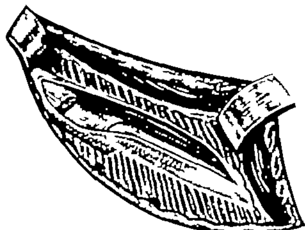
12 Exposure of the pleura

The periosteum on the rib is incised with a diathermy knife throughout the full length of the wound and then separated from the upper surface of the rib and from the back of the rib on its upper part. In large patients the incision can be purely intercostal for others it is necessary to remove a variable length of the third rib to produce sufficient exposure.



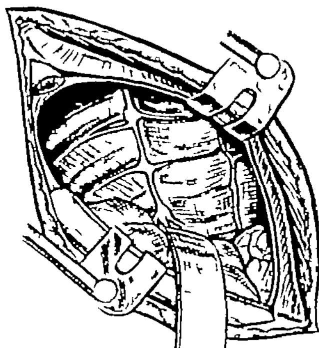
13 Opening the thorax

The pleura is opened through the periosteum in the upper part of the bed of the third rib This avoids damage to the intercostal vessels and nerve and this zone is relatively avascular A rib spreader is now inserted and the thorax opened to a width of about 4 inches. This usually provides sufficient exposure but if it does not the rib above may be divided subperiosteally and about 1 inch resected



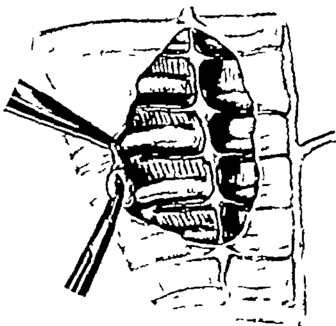
14 Exposure of the sympathetic chain

A large gauze pack is placed in the chest and the lung retracted downwards This exposes the dome of the pleura and the upper part of the mediastinal pleura and the pleura covering the bodies of the upper five thoracic vertebrae and the posterior portions of the corresponding ribs. The sympathetic chain can easily be seen beneath the pleura as it lies on the heads and necks of these ribs.



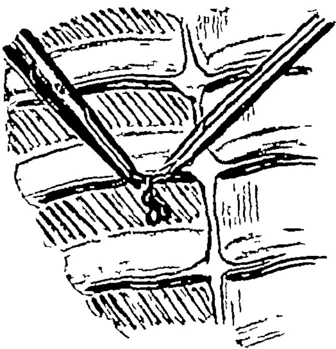
Mobilization of the sympathetic chain

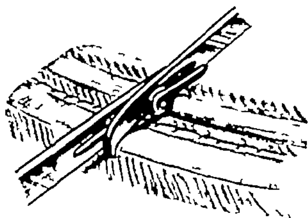
15 The parietal pleura is opened as it lies over the sympathetic chain and swept back for a short distance on each side with a gauze swab on a long holder The chain is then lifted up with a nerve hook below the fifth thoracic ganglion and divided. Traction is now applied to the chain and the rami communicantes divided between the second and fifth ganglia and the corresponding segmental nerves. The chain is then divided above the second ganglion and removed It is not possible to remove the lower portion of the stellate ganglion (first thoracic ganglion) with safety by means of an axillary incision.



Control of haemorrhage

16 Great care should be used in dissection to prevent bleeding, which, should it occur may be difficult to control. A small gauze swab on a long holder preferably a dental roll held in a long straight artery forceps should be pressed firmly on the bleeding point for five minutes it can then be picked up with a long artery forceps and coagulated with diathermy or controlled with a Cushing Mackenzie clip As the bleeding usually comes from an intercostal artery or vein, a meticulous technique should be employed otherwise the accompanying nerve may be damaged and neuralgia follow





Wound closure

17 Once a dry field has been obtained the lung can be inflated and the wound closed. The ribs are approximated and the periosteum and pleura in the rib bed closed with a continuous catgut suture. The fascia is then sutured and the skin closed. The anaesthetist keeps the lung fully inflated until the last skin suture has been inserted.

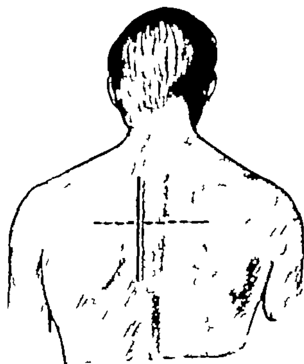
It is unwise to perform the axillary operation on both sides at the same operation.

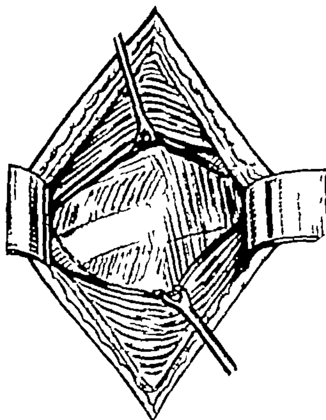


POSTERIOR APPROACH

The incision

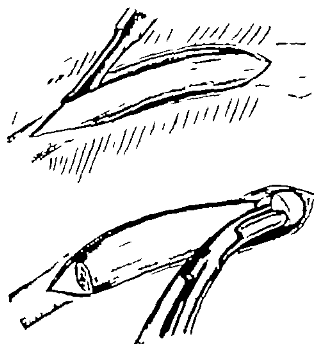
18 When bilateral, a long transverse incision across the back at the level of the third thoracic spinous process gives good exposure. For a unilateral operation a vertical incision about 6 inches long centred on the third spinous process is more usual. This is placed about half-way *between the midline and the inner* border of the blade of the scapula.





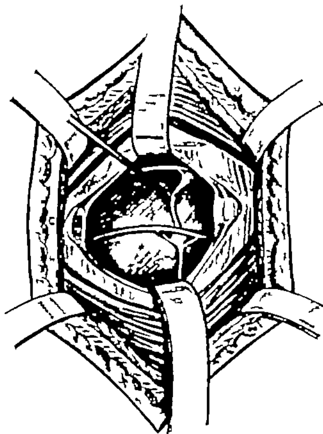
Division of the muscles

19 The trapezius muscle is divided throughout the length of the incision The next step is to insert a finger into the wound and carefully count the ribs to identify the third. This step is important if the standard Smithwick procedure is to be performed. A preliminary radiograph will have excluded a cervical rib and the third rib must be identified with certainty The major rhomboid muscle is now split in the line of the long axis of the third rib and the serratus posterior in the line of the incision. This exposes the erector spinae muscle, the attachments of which to the upper side of the third rib are now divided



Resection of the rib

20 The third rib is now exposed on its upper border and the periosteum over this bone from the neck to just beyond the angle incised with a diathermy knife. The periosteum is now removed from the rib and about 1½ inches in the region of the angle removed. The pleura is now depressed with a finger and the neck of the rib and transverse process of the third dorsal vertebra are removed with bone-nibbling forceps. An adequate amount of bone should be removed otherwise the exposure will be insufficient.

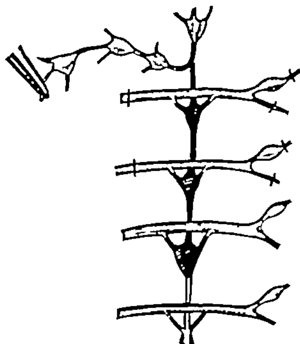


Identification of the sympathetic chain

21 The pleura is gently stripped with the finger from the backs of the second and fourth ribs and the sides of the bodies of the vertebrae. The third thoracic nerve is identified and the third ganglion and sympathetic chain isolated as it lies on the anterior surface of this nerve in line with the heads of the ribs. The second and fourth ganglia with the intervening chain are now found. A light introduced into the wound is of considerable help at this stage, because the exposure although adequate for the second and third ganglia is limited above and below this level.

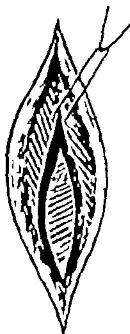
The sympathectomy

22 In the Smithwick procedure the third thoracic nerve is divided lateral to the sympathetic ganglion and then followed medially into the intervertebral foramen so that the anterior and posterior nerve routes can be sectioned. The second thoracic nerve is then treated in the same way. After this the sympathetic chain is sectioned below the fourth ganglion the rami of the second, third and fourth ganglia are divided and this portion of the chain placed in a silk bag and swung upwards and backwards where it is fixed in the erector spinae muscle mass. This procedure produces a satisfactory preganglionic section and little disability follows the sacrifice of the second and third thoracic nerves. However most surgeons today preserve the second and third nerves and do a sympathetic ganglionectomy removing the second, third and fourth ganglia.



Wound closure

23 It is rarely possible to suture the erector spinae or the serratus posterior muscle, which is therefore allowed to fall into the rib bed. The rhomboid muscle is sutured but forms only a weak layer The main strength of the closure is provided by the trapezius muscle which is carefully sutured, preferably with interrupted stitches. The skin is then closed.



SPECIAL POST-OPERATIVE COMPLICATIONS

Sympathectomy

A Horner's syndrome follows removal or the division of the rami from the first thoracic nerve to the stellate (inferior cervical) ganglion. This syndrome should only occur when the surgeon desires a sympathetic denervation of the head and neck. This syndrome may increase nasal obstruction by causing hyperaemia of the nasal mucosa. It has also been blamed for detachment of the retina in the elderly by reducing intra-ocular pressure.

Excessive dryness of the hands may be noticed. This can be prevented by rubbing the hands daily with an ointment consisting of equal parts of lanoline glycerin and white Vaseline with rose water

Anterior approach

Gentle retraction, particularly in the region of the brachial plexus is essential otherwise a temporary nerve palsy may follow

On the left side the thoracic duct may be injured. This is recognized by an escape of lymph. The treatment is careful ligation of the duct with transfixion sutures.

Axillary approach

A moderate degree of surgical emphysema often follows this procedure it is often present following operation by either of the other routes if the pleura is opened but it rapidly absorbs.

Posterior approach

The main disadvantage of this route is that severe and persistent pains may occur in the region of the scar Although uncommon these may be a serious disability

[The illustrations for this Chapter on Upper Thoracic Sympathetic Ganglionectomy were drawn by Mr R. N. Lane]

Bibliography

Atkins, H. B J (1949). *Lancet*, **2**, 1152.
Kinmonth, J B., and Hadfield, G. L (1952) *Brit. med. J.*, **1**, 1377
Lee McGregor A. (1955). *Surgery of the Sympathetic*. Bristol Wright.
Telford, E. D (1935) *Brit. J Surg.*, **23**, 448.
White, J C., Smithwick, R. H., and Simeone, F A. (1952). *The Autonomic Nervous System*. 3rd ed. London Kimpton.

LUMBODORSAL SYMPATHECTOMY AND SPLANCHNICECTOMY, PRESACRAL NEURECTOMY

CHARLES ROB M.C., M.CHIR., F.R.C.S
Professor of Surgery St Mary's Hospital, London
and
E. G TUCKWELL, M.CH., F.R.C.S.
Surgeon St. Bartholomew's Hospital, London Dean, St. Bartholomew's Hospital and St Bartholomew's Hospital Medical School, London

PRE-OPERATIVE

Indications

Certain patients with malignant or essential hypertension benefit from lumbodorsal sympathectomy and splanchnicectomy especially if the patient's condition worsens in spite of adequate medical treatment or if this treatment is not tolerated. Selection of patients for this operation is difficult. In recent years the operation has been used much less frequently in the treatment of hypertension than in the past.

The present position has been well summarized by Pickering (1955) when he stated that sympathectomy has a strikingly beneficial effect on a few patients, a good effect on some and perhaps no effect on others. It is a major operation with a low mortality in experienced hands, but with some post-operative sequelae, such as severe pain of a causalgic type and giddiness and palpitations on standing and on effort. The major difficulty which has not yet been solved is to determine in advance which patients will react well and which badly

This operation has also been used in the treatment of the severe pain associated with chronic relapsing pancreatitis and some other chronic intra-abdominal lesions.

Contra-indications

Significant impairment of renal function and uncorrected cardiac failure contra-indicate this operation.

Stages

The operation is a two-stage procedure with an interval of about 2 weeks between each side.

Anaesthesia

General anaesthesia with an endotracheal tube is satisfactory

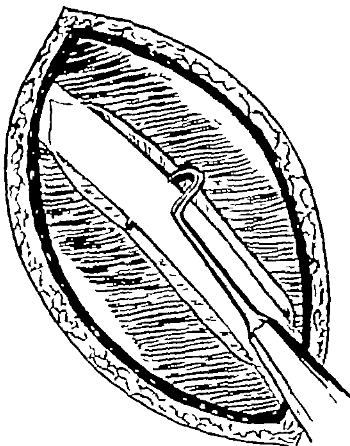
Approach

This may be via the thorax but the Smithwick operation, a thoraco-abdominal procedure, is the more usual method.

Transthoracic approach

Lying on the opposite side to that which is to be incised the patient is placed with the trunk rotated backwards towards the surgeon through 30 degrees and the head and feet lowered to extend the operation site.

THE OPERATION

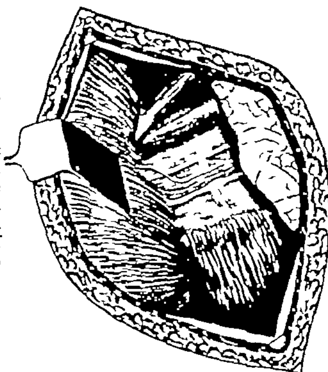


The incision

1 The incision is along the line of the ninth rib from its anterior tip to a point about 2 inches from the vertebral column. It is of help to infiltrate the tissues down to the rib with 1 : 250 000 adrenaline in saline solution to limit oozing from small blood vessels

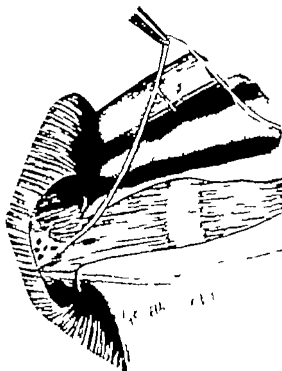
The periosteum of the rib is incised and a length of rib removed. If further exposure is needed 1 inch of the rib above may be removed as well.

The intercostal vessels are ligated at the posterior end of the rib bed and a 1-inch segment of nerve removed. The rib bed and pleura are incised to open the pleural cavity



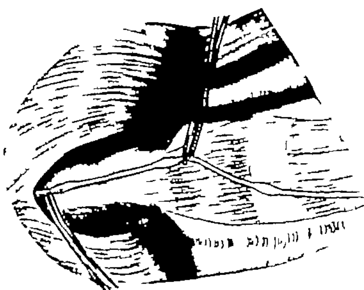
Exposure of the sympathetic chain and splanchnic nerves

2 The incision is opened wide by rib spreaders, the diaphragm retracted downwards by a Pozzi or Deaver retractor and the lung collapsed and held upwards by a pack. The great splanchnic nerve and sympathetic chain can be seen through the parietal pleura on the posterior chest wall. This pleura is incised between the nerves. The incision in the pleura is carried upwards (cephalad) to the level of the fifth rib and the flaps dissected back to expose the nerves and intercostal spaces.



Splitting the crus of the diaphragm and division of the splanchnic nerves

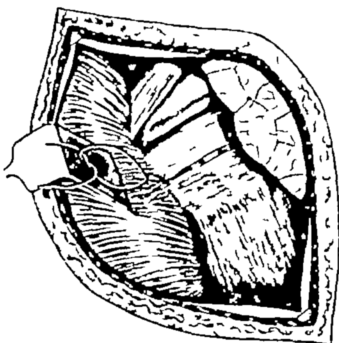
3 The diaphragm is split in the position of the crus and the hole widened by introducing a finger A long, flat malleable retractor can now be introduced through the diaphragm to lift up the abdominal viscera. The splanchnic nerves are cut off from the coeliac ganglion which is easily seen, and dissected upwards to the point where they join the gangliated trunk. This is carefully dissected off the intercostal vessels and nerves to the level of the fourth thoracic ganglion.



Removal of the first and second lumbar ganglia

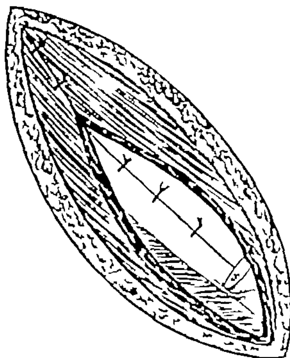
4 The dissection is continued and the whole sympathetic chain from the fourth thoracic to the second lumbar ganglion removed together with the three splanchnic nerves.

The suprarenal gland and kidney can be easily palpated and inspected by enlarging the incision in the diaphragm if necessary a renal biopsy may be taken.



Closure of the diaphragm

5 Any damaged intercostal vessels are secured with Cushing Mackenzie clips. The diaphragm is closed by sutures between the edges of the incision in the crus. The posterior pleura is *not* sutured.



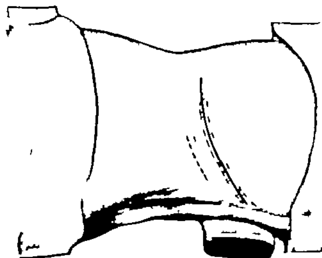
Wound closure

6 The wound is closed in layers of interrupted sutures and the lung fully expanded as the pleura is closed.

The skin is sutured without wound drainage.

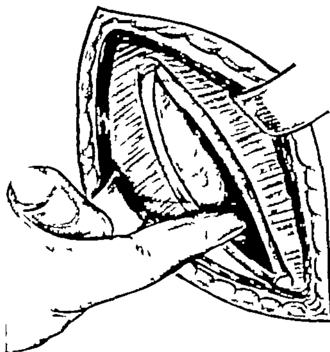
THORACO-ABDOMINAL OPERATION

The patient lies on his side in the nephrectomy position. The table should be broken or the bridge elevated so that the region of the twelfth dorsal vertebra is raised. The operation is made easier if the lateral tilt on the table is varied during the procedure to give adequate illumination.



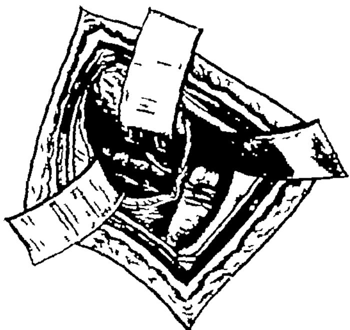
The incision

7 This follows the line of the last large rib from the outer margin of the sheath of the rectus abdominis to the sacrospinalis muscle. The rib is resected and the rib bed incised. Sometimes it is necessary to divide the ribs above and below



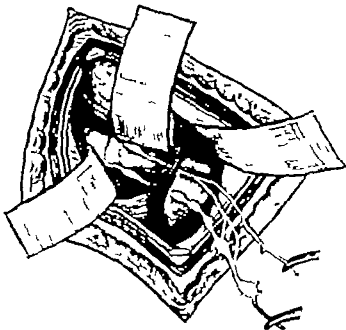
Stripping the pleura

8 In the posterior part of the incision the pleura is carefully detached and dissected off the posterior chest wall by blunt dissection this extends upwards and medially to expose the thoracic sympathetic chain and splanchnic nerves at least as high as the eighth segment and preferably higher



Incising the diaphragm

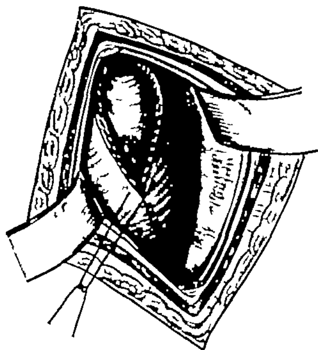
9 The anterior portion of the incision is opened by retracting the peritoneum forwards and medially. The diaphragm is then divided with scissors from its attachments to the ribs. Care must be taken to leave sufficient of this muscle at the peripheral side of this opening for its suture at the conclusion of the operation. This division of the diaphragm is carried as far as the point where it is pierced by the sympathetic chain. The kidney and adrenal are now examined to exclude an undiagnosed primary cause for the hypertension



The sympathectomy and splanchnicectomy

10 This is a combination of the thoracic sympathectomy and splanchnicectomy described earlier in this chapter and the high lumbar sympathectomy described on pages 28–34

The surgeon removes the sympathetic chain from the eighth thoracic to the third lumbar ganglion inclusive and over a longer length if possible. He also removes the three splanchnic nerves, these being divided close to the coeliac ganglion

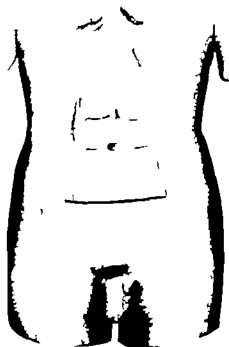


Wound closure

11 After haemostasis has been secured and after a renal biopsy has been taken, if this is thought necessary the wound is closed. First the diaphragm is united and then the lung is inflated. If the pleura has been opened it is usually impossible to close it under these circumstances the anaesthetist keeps the lung fully inflated until the skin closure is complete.

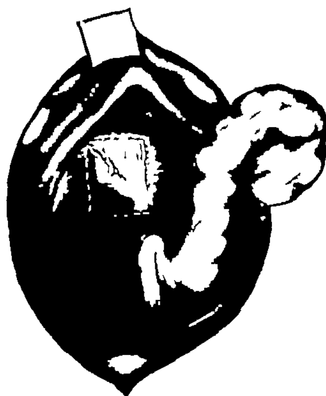
PRESACRAL NEURECTOMY

This operation has been used with benefit in certain cases of dysmenorrhoea and painful bladder following chronic cystitis particularly when there is evidence that the pain is associated with spasm of the internal sphincter



The incision

12 The patient is placed in a supine posture with a moderate Trendelenburg tilt. A transverse suprapubic skin incision with vertical midline incision opening the linea alba and peritoneum is satisfactory Alternatively the surgeon may employ any of the other studied lower abdominal incisions such as the paramedian.



The neurectomy

13 The intestines are packed out of the way to expose the posterior pelvic wall. The peritoneum between the iliac arteries is incised transversely and a block of tissue removed down to the fifth lumbar and first sacral vertebral bodies. The presacral "nerve" consists of a variable plexus in this region.

The posterior peritoneum should be sutured before abdominal closure.

SPECIAL POST-OPERATIVE CARE

There are usually few complications after the first side of a thoraco-abdominal sympathectomy. After the second side the patient should be nursed with the foot of the bed raised and, if the pulse rate rises and blood pressure falls the lower limbs should be bandaged and the angle of tilt of the bed increased. Very occasionally when the blood pressure falls to an alarmingly low level, an intravenous infusion of glucose-saline solution containing nor-adrenaline 2 ml. per litre may be given at a sufficient rate to maintain an adequate blood pressure.

If the patient suffers from postural hypertension when he leaves his bed the legs should be bandaged and a fairly tight abdominal binder applied.

This is an unduly painful operation and most patients require adequate doses of analgesic drugs for the first 3 or 4 days at least—pethidine 100 mg. 4-hourly if necessary. Some patients suffer from their worst pain between the fifth and tenth post-operative days.

A small pleural effusion may develop and if this increases in size it should be aspirated.

[The illustrations for this Chapter on Lumbodorsal Sympathectomy and Splanchnicectomy. Presacral Neurectomy were drawn by Mr. R. N. Lane.]

Bibliography

Pickering, G. W. (1955). *High Blood Pressure*. London: Churchill.

White, J. C., Smithwick, R. P., and Simeone, F. A. (1952). *The Autonomic Nervous System*. 3rd ed. London: Kimpton.

LUMBAR SYMPATHETIC GANGLIONECTOMY

CHARLES ROB, M.C., M.CHIR., F R.C.S.
Professor of Surgery St Mary s Hospital London
and
E. G TUCKWELL, M.CH., F.R.C.S.
Surgeon St Bartholomew s Hospital, London Dean St Bartholomew s Hospital and St Bartholomew s Hospital Medical School London

PRE-OPERATIVE

Indications

The principal indication for lumbar sympathetic ganglionectomy is arterial insufficiency in the lower limb due to atherosclerosis with thrombosis, thromboangiitis obliterans, an embolus or an injury Under these circumstances the level of denervation should be planned to denervate the area where the artery is occluded so that the collateral circulation around the occlusion may be improved. Thus removal of the second and third ganglia denervates the limb as measured by skin sweating tests from the lower third of the thigh distally inclusion of the first lumbar ganglion carries the denervation to the groin and the lower two thoracic ganglia must be removed as well if the buttock is to be included. Other indications include hyperidrosis of the feet, acrocyanosis, erythrocyanosis, erythromelalgia, Raynaud s phenomenon the cryopathies, old poliomyelitis, causalgia, and traumatic arterial spasm. In cases of doubt a preliminary lumbar ganglion block (page 7) is the best method of judging the likely response to operation.

Effect on sexual function

Bilateral removal of the first lumbar ganglion in many patients results in interference with the function of ejaculation. Therefore, in young men, this ganglion should be preserved on one side if possible.

Anaesthesia

General anaesthesia is satisfactory

Approach and position of the patient

This will depend upon which portion of the sympathetic chain is to be removed. For removal of the second and third lumbar ganglia a transverse anterior abdominal incision, bilateral if necessary provides good exposure. For this operation the patient lies on his back and a small sandbag may be placed under the buttock of the same side as that to be operated on.

Removal of the first lumbar ganglion is not always possible through this anterior incision and it is wise, when this ganglion is to be removed, to employ a postero-lateral incision through the bed of the twelfth rib with the patient in the lateral position used for nephrectomy

The removal of the lumbar chain with the lower thoracic ganglia has been described on page 22

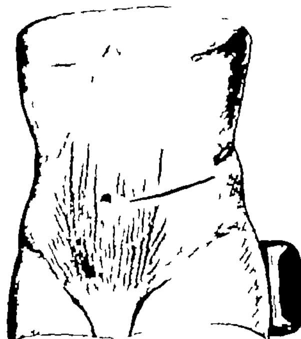
THE OPERATIONS

ANTERIOR APPROACH

This is the best route of approach to the second and third lumbar ganglia and the intervening chain.

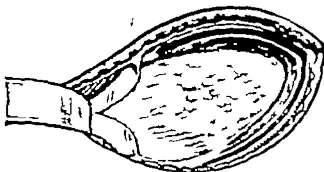
The Incision

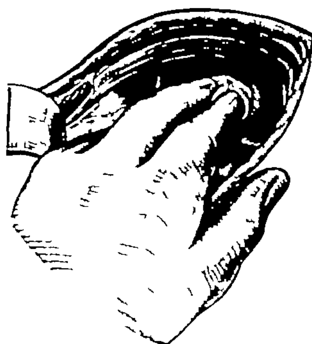
1 A curved incision bilateral if necessary is made in the line of the skin creases of the abdominal wall. Laterally the incision starts just below the costal margin at the level of the tip of the eleventh or last large rib Medially it ends about 1 inch from the mid-line at the level of the umbilicus. The incision should be about 6 inches long and the approach is extra-peritoneal.



Muscle incision

2 The lateral portion of the sheath of the rectus abdominis muscle is divided in the line of the incision and the external oblique tendon and muscle incised as far as the posterior end of the incision. The internal oblique and transversus muscles are then incised to expose the peritoneum and extraperitoneal fat. The rectus abdominis muscle is retracted medially and the lateral part of the posterior sheath of this muscle opened in the line of the incision.

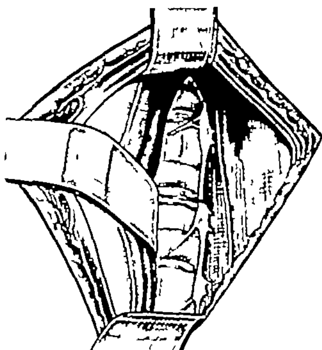




3

Extraperitoneal dissection

Starting in the lateral part of the wound the peritoneum is stripped by digital and gauze dissection from the anterior lateral and finally the posterior abdominal wall. Deep retractors are now inserted and the peritoneum displaced medially to expose the psoas muscle. The ureter is lifted up with the peritoneum. If the peritoneum is opened in error it should be sutured at once and the dissection continued in the extraperitoneal plane.



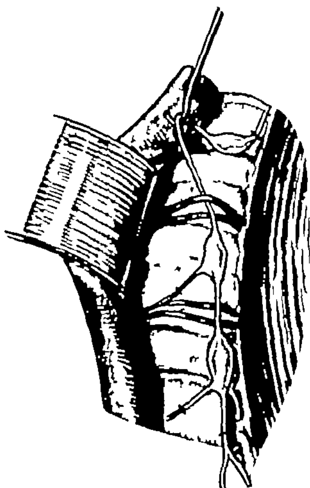
4

Exposure of the sympathetic chain

The sympathetic chain lies just medial to the psoas muscle on the front of the vertebral bodies. On the right side it is covered by the inferior vena cava on the left it lies close to the side of the aorta. After gentle retraction of the inferior vena cava or the aorta, the sympathetic chain is identified by palpation. The only structures likely to be confused with it are the genito-femoral nerve, which lies about 1 inch to the outer side of the sympathetic chain and is not gangliated, and the lymph nodes. Once located the sympathetic chain is exposed by gauze and scissor dissection and its identity confirmed visually

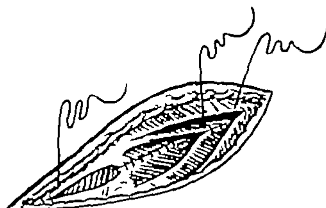
The sympathectomy

5 The sympathetic chain is picked up with a nerve hook and the second and third ganglia freed from their attachments including the rami communicantes. The chain is then divided above the second and below the third ganglion and removed. During this dissection great care should be taken to avoid injury to the lumbar veins. These pass behind the sympathetic chain, but very occasionally one or more of these veins passes anterior to the chain, when they must either be divided or the chain carefully threaded out from behind them.



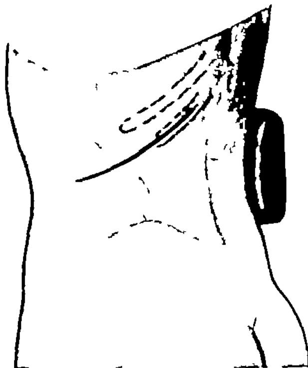
Wound closure

6 Once haemostasis is secured the retractors are removed and the wound closed in layers. First the transversus abdominis muscle and the posterior sheath of the rectus abdominis muscle are united, then the internal oblique muscle and, lastly the external oblique muscle and the anterior sheath of the rectus abdominis muscle.



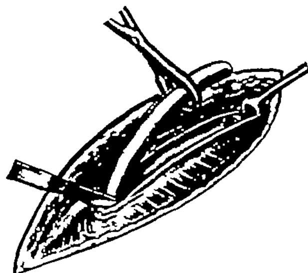
THE POSTERO-LATERAL APPROACH

The patient is placed on his side in the lateral or nephrectomy position. This approach allows the removal of the first lumbar and lower thoracic ganglia in addition to the main lumbar sympathetic chain.



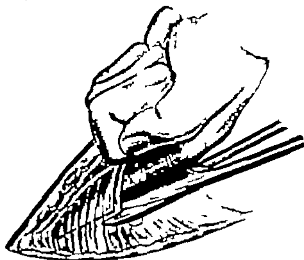
The incision

7 The incision follows the line of the twelfth rib It starts behind at the outer border of the sacrospinalis muscle and is carried forwards for a distance of 6–8 inches. The latissimus dorsi muscle is divided in the line of the incision which exposes the anterior portion of the twelfth rib The periosteum on the exposed portion of this bone is incised with a diathermy knife and skin towels applied



Resection of the twelfth rib

8 The periosteum covering the anterior portion of the twelfth rib is stripped away and the rib divided close to the lateral margin of the sacrospinalis muscle care being taken to avoid injury to either the pleura or the twelfth thoracic nerve or vessels. The anterior portion of the twelfth rib is now lifted up with bone-holding forceps and its removal completed by dissecting the tip of this rib away from its attached muscles and costal cartilage if present.

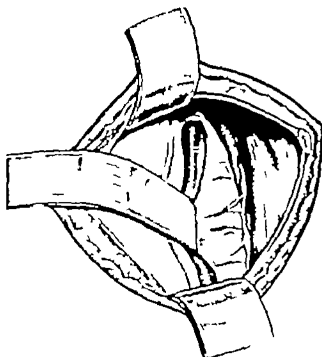


Division of the abdominal muscles

9 A finger is now introduced into the wound at the anterior end of the rib bed and passed forwards in the line of the incision between the abdominal muscles and the peritoneum. These muscles are then divided with scissors in the line of the incision. If careful attention is paid to the position and direction of the twelfth thoracic neuro-vascular bundle, it is possible not only to avoid injury to the twelfth thoracic nerve but also to minimize bleeding from the division of this fairly large muscle mass.

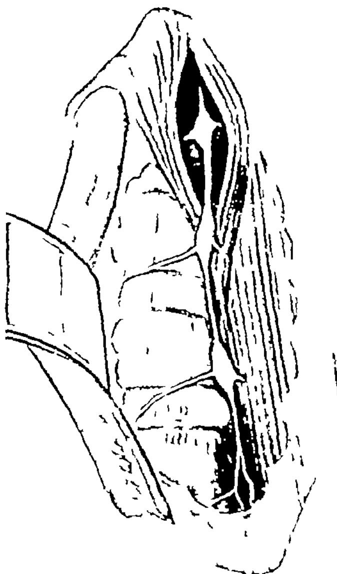
Exposure and identification of the sympathetic chain

10 The peritoneum is now stripped away from the posterior and lateral sides of the abdominal wall and held well forwards with deep retractors. The ureter remains adherent to the peritoneum and strips with it. The sympathetic chain is now identified by palpation at the level of the second and third lumbar ganglia as it lies on the part of the vertebral column at the inner edge of the psoas muscle, behind the inferior vena cava on the right and by the side of the aorta on the left. The chain is divided below the third ganglion and the second and third ganglia are mobilized from their attachments.



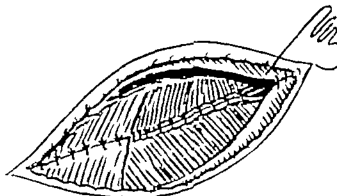
The sympathectomy

11 The sympathetic chain is now held up in forceps and the dissection carried upwards from the second ganglion. The chain is followed into the crus of the diaphragm. First the lumbocostal arch and then the crus are split to expose the first lumbar ganglion. This is freed from its attachments and the sympathetic chain from the first to third lumbar segment, removed. If the surgeon wishes to include the lower thoracic ganglia in this removal then the incision is similar and the ganglia are reached by stripping the pleura and dividing the diaphragm in the manner described on pages 24-25



Wound closure

12 The retractors are removed and the peritoneum is allowed to fall back. The transversus abdominis muscle is then sutured and after it the internal oblique muscle The periosteum in the rib bed is not repaired but the tendinous and muscular attachments to the tip of the first rib are united. It is important to avoid including the twelfth nerve in any of these stitches. The external oblique and latissimus dorsi muscles are now sutured and the skin closed. If the pleura has been opened the lung is kept fully expanded until the completion of the skin closure.



POST-OPERATIVE CARE

After either the anterior or posterior operation paralytic ileus may occur although in each case the procedur has been extraperitoneal. This ileus is usually mild and rarely requires active treatment. Should it be severe th treatment is by gastric aspiration, intravenous fluid and electrolyte replacement.

[The illustrations for this Chapter on Lumbar Sympathetic Ganglionectomy were drawn by Mr R. N Lane]

Bibliography

Leriche, R., and Fontaine, R. (1933). *Pr med.* **41**, 1819
McGregor A. Lee (1955). *Surgery of the Sympathetic* Bristol Wright.
Royle, N D (1924). *Surg Gynec. Obstet.*, **39**, 701
White, J C., Smithwick, R. P., and Simeone, F A. (1952). *The Autonomic Nervous System.* 3rd ed. London Kimpton.

VARICOSE VEINS

JOSEPHUS C. LUKE, M.B.E., M.D., F.A.C.S., F.R.C.S. (ENG.) & (C.)

Assistant Professor of Surgery McGill University Montreal Associate Surgeon Royal Victoria Hospital Montreal Consulting Surgeon Queen Mary Veterans Hospital Montreal Canada

PRE-OPERATIVE

Indications

Surgical treatment of varicose veins is indicated when the Trendelenburg test reveals incompetence of the valvular mechanism in the saphenous systems with reverse flow or stasis in these systems when the patient is upright. The majority of cases treated will be those with congenital uncomplicated varicose veins but others will be more advanced and show the complications of eczema ulceration indurations and superficial phlebitis. In those patients who have had a previous deep thrombophlebitis and who now show incompetent superficial veins, these procedures are also indicated but with a much more guarded prognosis and the need for further leg care than when primary varicose veins are treated.

Special contra-indications

In the presence of infective sequelae such as ulceration eczema or other inflammatory lesions on the leg these complications should be healed before definitive treatment for the varicose veins is carried out. Bed rest with leg elevation or the wearing of a special Unna's compression bandage will heal the majority of these complications prior to surgery. Cirrhosis of the liver cardiac failure, pregnancy (not necessarily a contra-indication to operation) and arteriovenous communications should be excluded as a cause of vein enlargement prior to surgery

Pre-operative preparation

The patient is to be admitted the evening before operation and general physical examination, urine examination and a haemoglobin estimation carried out. Shaving of the lower abdomen both legs and genitalia is carried out along with the usual pre-operative measures.

Anaesthesia

Spinal anaesthesia is excellent, but the author has had too high a percentage of spinal headache to recommend this type wholeheartedly. Pentothal with nitrous oxide removes this disadvantage is more acceptable to the patient and is the method of choice at the present time.

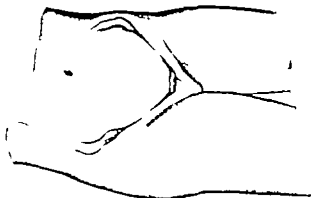
Position of the patient

As a rule, the saphenous veins of both legs will be involved and consequently a bilateral operation will be required. The patient should be stripped to the umbilicus on the operating table. Shoulder braces are a necessity in this operation as the Trendelenburg position is assumed during the actual vein stripping. The skin of both legs, feet genitalia and lower abdomen are sterilized. Sterile rubber gloves are placed over the forefeet.

(The illustrations depict the procedure as carried out on the patient's right leg.)

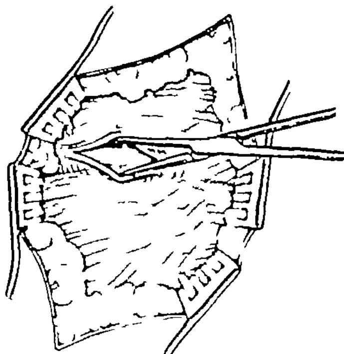
THE OPERATION

ROUTINE STRIPPING



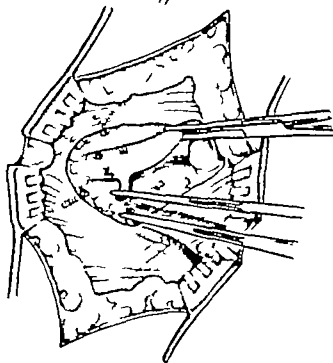
The incision

1 The incision for high ligation is placed in the crease of the groin with its mid-point just medial to the femoral artery and it usually need not be longer than 3 inches in the average patient.



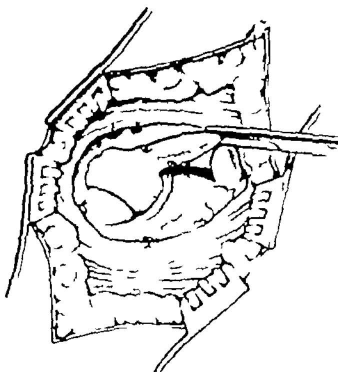
Division of Scarpa's fascia

2 The incision is deepened until the subcutaneous fascial layer continuous with Scarpa's fascia is divided. At this level, if the patient is not too obese, the bluish saphenous vein will be seen in the fat and further dissection is continued only in line with the vein. Too extensive dis-*section at this stage is harmful as the femoral* lymph nodes and lymphatic channels should not be disturbed.



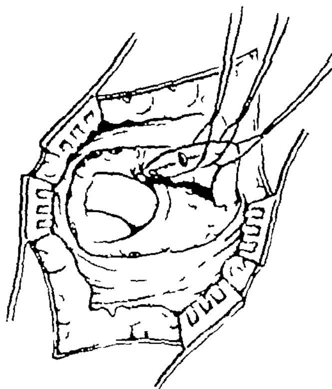
Freeing the saphenous vein and division of tributaries

3 Freeing the saphenous vein is made simple by holding it with a haemostat and dissecting further in the areolar layer immediately outside the vein wall. This is the greatest single aid in the proper exposure of the sapheno-femoral junction. Numerous tributaries will be encountered as the junction is approached and these are divided between haemostats and ligated. The anatomy of these tributaries is most variable and seldom conforms to the anatomical text-books. Following division of each tributary the dissection can be advanced to the junction. The anterior aspect of the common femoral vein should be visualized as this is the only way to be certain that a flush high ligation of the saphenous will be performed.



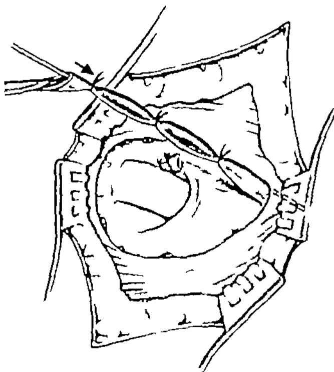
Locating the common femoral vein

4 Visualization of the free edge of the fossa ovalis will also be a guide to the common femoral vein Normally the superficial external pudendal artery runs on this edge but occasionally it will be abnormal and cross anterior to the vein. Unless a careful dissection of the sapheno-femoral junction is done divisions or tributaries of the saphenous will be missed and will be a potent factor in the formation of recurrent veins.



Ligating the saphenous vein

5 The saphenous vein is ligated at its junction with the femoral by two ligatures spaced about ¼-inch apart. It is preferable *not to transfix* the vein in placing these ligatures Three heavy ligatures are placed over the distal section of the vein with an untied single knot. These ligatures will be tied over the stripper *when it* is introduced.



Introducing the stripper into the vein

6 The stripper is introduced down the vein and the heavy ligatures are tied spaced about ¼-inch apart. The author prefers to start the stripping from above progressing down as far as possible until halted by a varix. When the upper vein segment has been removed, the saphenous is then exposed just distal to the medial malleolus and stripped upward. In this way reduplications of the saphenous will be discovered which otherwise might have been missed.

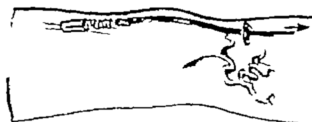
Of the many strippers available the Jones cup stripper is preferred by the author



Exit at the knee

7 Occasionally the stripper can be introduced to the ankle without interruption but this is uncommon especially in the advanced case with tortuous veins. The stripper is most frequently halted just below the knee where the end can be palpated and a small horizontal incision made over it.

After opening the vein and ligating it distally steady traction is applied to the stripper until both the instrument and the attached venous segment are removed from the patient.

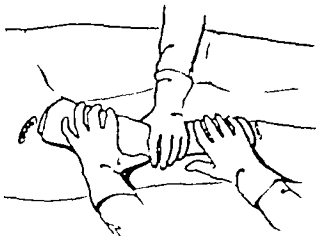


Stripping

8 Before stripping is commenced the anaesthetist should be instructed to put the patient in Trendelenburg position. This decreases the blood pressure in the vein and minimizes bleeding from the torn branches at the time of stripping

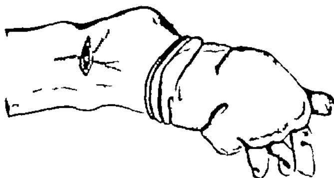
Hand pressure following vein removal

9 Immediately after the vein segment has been removed a rolled up towel is placed along the course of the vein and pressure applied for 2–3 minutes. This also aids in controlling bleeding from torn tributaries. If these precautions are not applied, post-operative ecchymosis may be extensive and haematoma formation along the course of the stripped vein produces painful indurations which take several weeks to clear



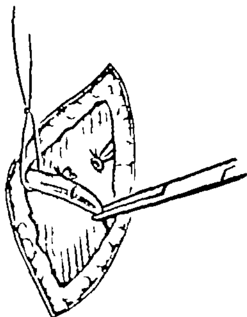
Exposure of the saphenous vein at the ankle

10 The lower end of the great saphenous is next exposed in its course just below and anterior to the medial malleolus. In this area it rapidly diminishes in size due to several large branches which require ligation.



Introduction of the stripper

11 The vein is partly divided and a heavy ligature placed but not tied. The stripper is introduced centrally the ligature tied on the vein over the stripper and the distal end of the vein divided and tied.



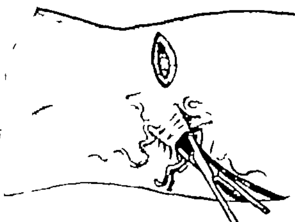
Distance of stripping affected by venous tortuosity

12 The distance the stripper can be introduced upward will vary with the extensiveness and tortuosity of the varices. Further incisions are required each time progress is impeded. As many as six ladder incisions may be required to remove a severely involved and tortuous vein.



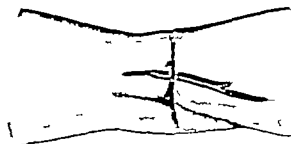
Excision of large tortuous vessels

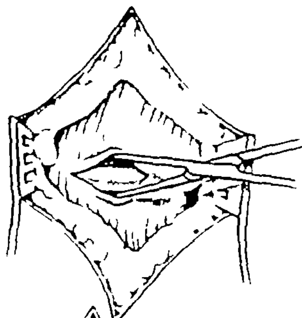
13 In patients with large varicose branches which are too tortuous to be stripped, large segments of these branches can be excised through small incisions by careful subcutaneous dissection Or the surgeon can make larger incisions to remove, under direct vision, large varicose tributaries or segments of the main vein which are too tortuous for stripping



ASSOCIATED SMALL SAPHENOUS INCOMPETENCE

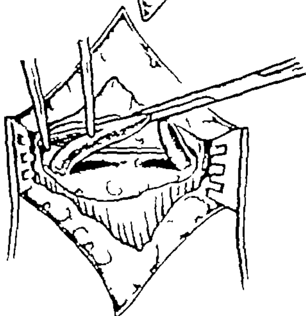
14 About 20 per cent of cases also show associated incompetence of the small saphenous vein. It is important not to overlook this vein otherwise the result is far from perfect. The small saphenous is approached by a transverse incision in the popliteal crease





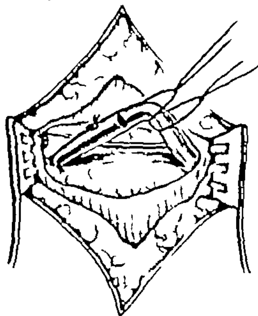
Exposure of the vein

15 After the subcutaneous tissue has been divided the small saphenous vein can be seen shining beneath the deep fascia of the popliteal space A vertical incision is made through the fascia in line with the vein



Dealing with the small saphenous tributaries

16 The small saphenous is picked up dissected free and traced upward into the popliteal space Only one tributary is encountered entering the vein obliquely from above. After this branch is divided the vein can be followed well into the popliteal space. The sural nerve which runs adjacent to the vein should be protected.



Placing the stripper ligatures

17 Although ideal, it is usually unnecessary to ligate the small saphenous vein flush with the popliteal vein because of the fact that only one tributary exists in this region. The stripper ligatures are placed and the vein opened as in the great saphenous procedure.

Introduction of the stripper

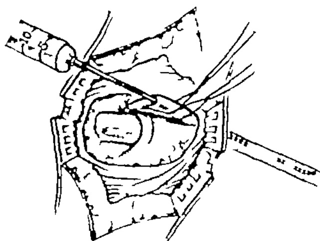
18 The stripper is introduced downward and will be seen to progress to the ankle where it is exposed just below and behind the lateral malleolus. If the stripper is halted due to a varix in mid-calf, the vein is found at the malleolar area and stripped upward. Compression is applied along the course of the vein as in the great saphenous technique.



ALTERNATIVE PROCEDURE

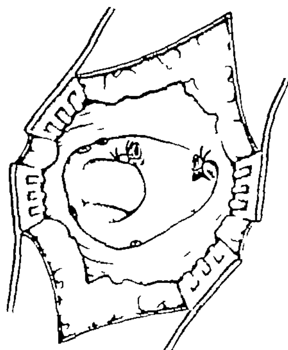
Injection of sclerosants as an alternative

19 An alternative technique to stripping is that of ligation and the retrograde introduction of sclerosing solutions It is the author's opinion that results from this procedure are inferior to those of stripping and it should be used only in exceptional cases The sapheno-femoral junction is exposed as before the saphenous ligated and a long cannula introduced down the vein. Not more than 5 ml. of sclerosing fluid should be injected. The best at present in use is sodium tetradecyl sulphate.



Section and ligation

20 The sclerosing fluid in the syringe should be diluted with blood up to 15 ml. and the injection done with some force to send the mixture as far distally in the vein as possible Following removal of the cannula a short segment of the saphenous is excised and the distal vein ligated The small saphenous can be similarly treated if required but the total amount of sclerosing fluid used should not exceed 5 ml. in each leg Subsequent percutaneous injections of sclerosing fluid are usually necessary to complete the procedure

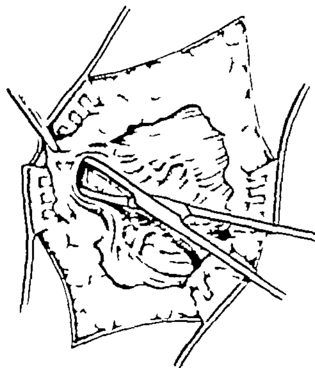




RE-LIGATION

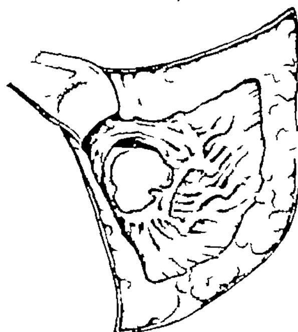
The incision

21 The technique of high saphenous ligation has been practised for many years and many cases have been done by inexperienced surgeons who have not carried out a proper flush saphenous ligation Recurrent veins have appeared, the Trendelenburg test is still positive and re-ligation and stripping is indicated The author has devised the following approach for the difficult procedure of re-ligation The former incision in the groin is usually found to be too low and a new incision is made in the groin crease



Exposure avoiding the scar tissue

22 Exposure through the scar resulting from the previous operation is difficult and numerous dilated tributaries add to the tribulations. This scarred area is therefore left undisturbed and dissection proceeds obliquely upward toward the inguinal ligament in fresh tissue



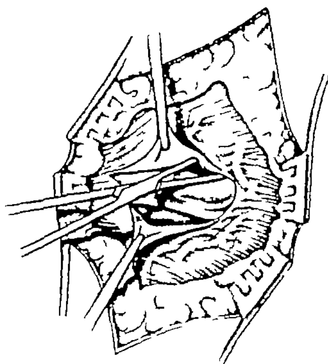
Dissection along the femoral vein

23 The sheath surrounding the common femoral vein is identified easily in its medial position to the femoral artery This sheath is opened and the femoral vein exposed. Dissection is then carried distally along the vein in the areolar surrounding layer which has been undisturbed by the previous surgeon

Dissection to the saphenous junction

24 As the exposure progresses distally along the sides of the femoral vein, the saphenous junction will come into view The old scar tissue will be encountered but this is superficial to the plane of dissection and need not be disturbed.

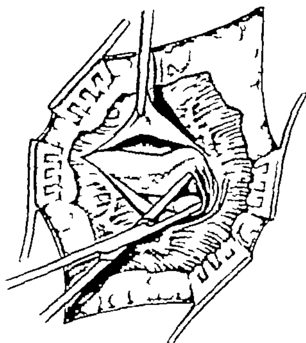
The superficial external pudendal artery should be identified as it runs on the free edge of the fossa ovalis Division of this artery will facilitate the dissection



Exposure beyond the saphenous junction

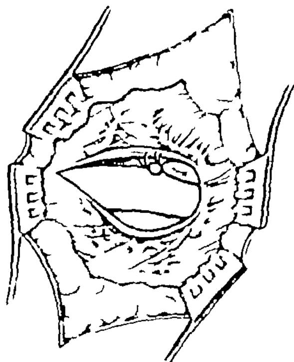
25 The femoral vein is exposed downward for another ½-inch beyond the saphenous junction when the distal edge of the saphenofemoral junction will be seen A curved haemostat is gently insinuated beneath this edge

Some of the superficially placed scar tissue will need to be divided to give exposure of the distal surface of the saphenous curve This can be done boldly as the femoral vein is in constant view and so removed from harm.



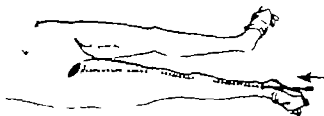
Ligation of the saphenous vein

26 Two ligatures are then placed around the saphenous at the point of junction and tied about ¼-inch apart. This gives an absolutely flush saphenous ligation proximal to all tributaries. It is unnecessary to look for the remaining tributaries because of this flush ligation. Due to the previous surgery and the resultant scar it is usually impossible to identify the upper end of the saphenous and therefore stripping from the upper end cannot be carried out.



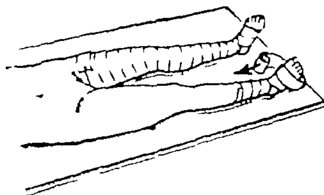
Upward stripping

27 The saphenous vein is isolated at the ankle as just described, and upward stripping carried out. Or the saphenous can be picked up at any level where it is easily accessible and both central and distal stripping performed. In these recurrent cases the stripping is more difficult than in the virgin case and the length of vein stripped is, as a rule, not as complete. Subsequent injections of sclerosing fluid are necessary to eliminate the residual varices, the pattern of which is usually quite bizarre.



SUPPORTIVE BANDAGING

28 Following the routine or recurrent stripping procedure crepe elastic bandages are applied to the legs on the operating table before the patient is returned to the horizontal. These should reach almost to the groin and their support further reduces subcutaneous ecchymosis and gives a great measure of comfort.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Complications arising during the operation

Despite the utmost gentleness, occasionally a tear of a thin saphenous vein will result near the femoral junction. Massive bleeding occurs and if a definite plan is not followed blind clamping will damage the femoral vein and even the femoral artery Firm pressure is exerted in the wound and the patient is placed in steep Trendelenburg position The suction apparatus is made ready Upon release of the digital pressure, the bleeding is found to be minimal and the field can be kept clear by the suction. The reduction in bleeding results from the decreased pressure in the veins incident to the Trendelenburg position. If the tear is small it can be clamped and ligated if larger or in the femoral vein it should be repaired using 00000 arterial silk.

The use of shoulder braces on the operating table is a necessity in every case because the Trendelenburg position is assumed during the actual stripping They are most necessary if the accident described above should occur These braces should be applied with care because a heavy patient can develop varying degrees of arm paralysis after prolonged head down position if this is neglected. The braces should be placed out toward the tip of the shoulder and not allowed to exert pressure toward the base of the neck. The arms should be at the patient's sides and not in the abducted position as this position increases the possibility of brachial plexus pressure. Fortunately palsies are not too serious and will clear spontaneously in about 6 weeks or sooner

Post-operative care

The patient is out of bed the day following operation and discharged from hospital the second post-operative day Walking to the limit of tolerance is encouraged but the legs should be elevated whenever the patient sits. The elastic bandages are worn until return to the outpatient department on the seventh post-operative day when the sutures are removed. Some degree of skin ecchymosis is usually present but disappears in about 10 days. An indurated line along the course of the stripped vein is usually present. This results from the haematoma formation along the tunnel of the removed vein and is severe if the compression treatment previously indicated is not carried out. These indurations are usually tender and may be painful but disappear in about 4 weeks.

Varying degrees of oedema of the foot and ankle occur in a small proportion of cases. This results more commonly in those cases where the great and small saphenous veins have been stripped and in those individuals where the lymphatic return is congenitally weak This latter point can be assumed from a history of ankle oedema in hot weather or on prolonged standing This post-operative oedema will usually clear spontaneously but may require bandaging for a time

Most cases will need to report for subsequent injections of sclerosing fluid to clear up remaining branches It is not feasible to surgically chase every branch to its termination. The surgeon should not promise that new veins will not appear in the succeeding years as a branch not dilated at the time of operation can become so in time due to continuation of the patient's hereditary tendency in this respect. Each patient should be requested to report for examination once a year for the obliteration of any new varices. In this way the result will be maintained and the complaint that the veins have all come back will be obviated.

[The illustrations for this Chapter on Varicose Veins were drawn by Miss Helen MacArthur]

Bibliography

Griffith, C. A., and Harkins, H. N (1955) "The Present Status of the Surgical Treatment of Varicose Veins with Special Emphasis on Vein Stripping" *West. J Surg* 63, 245
Lenn, W., and Langmaack, B H. (1955) "Die Grenzen und Gefahren der Varizenverödung" *Dtsch med. Wschr* 80, 237
Luke J C. (1954). "The Management of Recurrent Varicose Veins." *Surgery* 85, 40

LIGATION OF THE ANKLE-PERFORATING VEINS

F B COCKETT M.S., F.R.C.S
Surgeon St Thomas's Hospital London

PRE-OPERATIVE

Indications

The direct ankle-perforating veins in the lower half of the leg are the main channels of venous drainage of the ankle skin into the deep veins of the calf. In the erect exercising limb nearly all the venous blood from the superficial tissues drains this way. Incompetence or destruction of the valves in one or more of these veins allows a high-pressure reflux from the calf into the ankle skin and subcutaneous tissues, resulting in widespread venular dilatation and ankle swelling. As time goes on such lesions as eczema, subcutaneous fat necrosis and fibrosis and ulceration may make their appearance (the so-called "post-phlebitic syndrome").

Thus in any case in which these lesions are present round the ankle it is probable that one or more of the ankle-perforating veins are incompetent, and their ligation is indicated. The sites of the incompetent perforators can sometimes be seen on inspection of the leg. In more advanced cases their presence is completely disguised by the indurated oedematous ankle skin overlying them, and their incompetence is only to be suspected because of the presence of the ulcer and induration and because of the presence of a flare of dilated venules below the internal malleolus (the ankle flare).

Pre-operative treatment

This operation must never be done when the leg is oedematous, in the presence of an active eczema, or in the presence of an open infected ulcer. The essential pre-operative treatment is a period of Bisgaard pressure bandaging to control the oedema, and to bring the ulcer into a healing phase. This must usually be supplemented by a few days' rest in bed, with the foot of the bed raised, before operation. Surface sepsis on the ulcer must be controlled by local streptomycin applications (1/1 000 streptomycin in saline). A large surface ulcer may have to be covered with postage stamp grafts before the operation can be performed.

Position of the patient

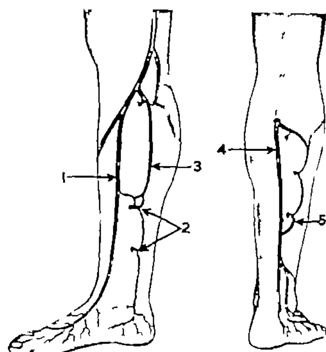
Operations on the perforating veins should be done with the patient lying flat on the back, with the legs widely apart on a foot board, and the table tilted head down about 20 degrees to reduce the bleeding during the operation. The operator sits at the foot of the table.

THE OPERATION

Anatomy of the ankle-perforating veins

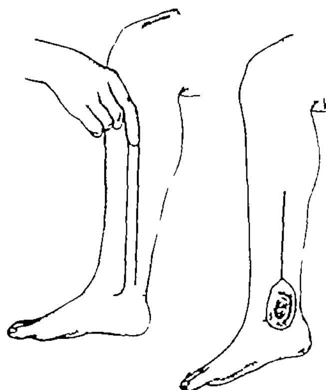
1 On the inner side of the limb there are two main direct perforating veins (2) emerging from holes in the deep fascia. They are situated *behind* the great saphenous vein (1) The upper one is approximately half-way up the leg The lower one is four finger-breadths above the internal malleolus. Note that the perforating veins communicate by fine venous arches, and also with the great saphenous vein by a large constant posterior arch vein (3) arising at knee level.

On the outer side of the limb there is only one constant large perforator (5) which communicates directly with the short saphenous vein (4)



The incision

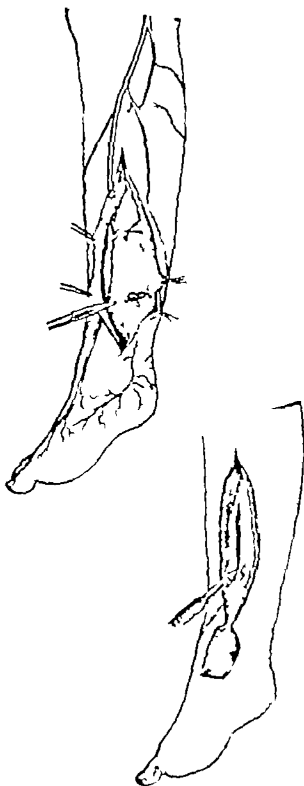
2 The incision starts just above half-way up the leg one finger-breadth behind the medial subcutaneous border of the tibia. It is carried straight down to a point half-way between the medial malleolus and tendo Achillis. If there is an unhealed local ulcer in the ankle region this is completely excised to the full depth of the skin as part of the incision. This defect is then grafted 2 or 3 days later



The extrafascial operation

3 When the subcutaneous tissues are in good condition, freely mobile and contain large palpable masses of veins, the extrafascial approach is used. The line of emergence of the perforators is cut down on. Any large vein in the subcutaneous tissues is then identified and followed up and down—it will lead to one or other of the enlarged perforating veins.

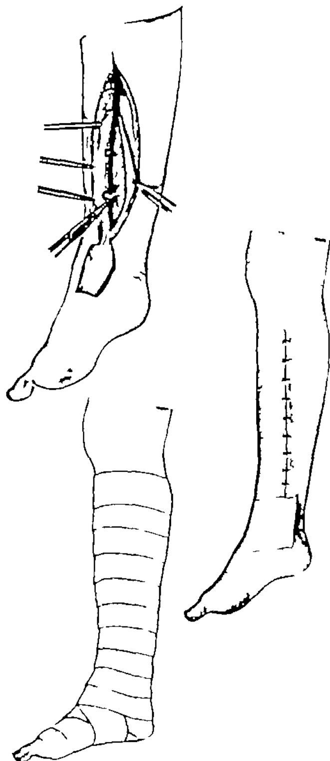
Too much lateral dissection must not be carried out in this plane, otherwise necrosis of skin flaps may occur. However, under the anterior flap the great saphenous vein can be identified and used to insert a stripper. Stripping of an incompetent great saphenous vein can thus be combined with ankle-perforator exploration.



The subfascial operation

Incision through fascia

4 This operation is performed through the same incision. It is more suitable for the case with the indurated leg in which the skin has been bound down to the underlying fascia. The knife is carried straight down through the deep fascia, exposing the muscle.



5 *Subfascial exploration*

A number of artery forceps are then attached to the deep fascia of the anterior aspect and this flap is lifted up and the perforating veins sought as they pass from muscle to deep surface of fascia. In this plane wide lateral and medial dissection can be done without jeopardizing the blood supply of the skin All ligating should be done with fine catgut—unabsorbable ligatures should never be used.

6 **Closure**

A few fine catgut sutures may be placed in the fascial layer to draw it together but these are not strictly necessary The skin is best closed by a few mattress sutures of nylon If the skin of the ankle cannot be closed without tension, it is best left open and the elliptical defect grafted at a later date. The limb is then enclosed in a firm pressure webbing elastic bandage.

POST-OPERATIVE CARE

Special after-treatment

The limb is elevated for 8–7 days after operation according to its extent, and enclosed in a firm pressure webbing elastic bandage Ankle movements are initiated at once, and the stitches are removed on the tenth day From the seventh day onwards the patient is ambulant and encouraged to walk with a firm webbing elastic bandage this bandage is a *necessity* in the after-treatment and should be worn for at least one month or more after operation then it is gradually discarded.

[The illustrations for this Chapter on Ligation of the Ankle-perforating Veins were drawn by Miss J Dewe]

Reference

Dodd, H., and Cockett, F B. (1956). *Pathology and Surgery of the Veins of the Lower Limb* Edinburgh Livingstone.

GRAVITATIONAL ULCERS

R. P Jepson F.R.C.S

Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

PRE-OPERATIVE

The term gravitational ulcers describes ulceration of the lower leg associated with incompetence of the superficial or deep venous system The procedures designed to treat such ulcers (some of which are described in other chapters in this Part) are of two groups (1) those thought to improve the venous efficiency of the limb (ligation or stripping of incompetent superficial veins ligation of superficial femoral or popliteal veins) and (2) those which accelerate the healing of the ulcer (local supportive therapy sterilization of ulcer with excision and skin grafting lumbar sympathectomy)

STERILIZATION OF ULCERS

Indications

Sterilization may be done prior to excision and grafting of ulcers, venous ligation or stripping, or where the ulcer is grossly infected with a surrounding cellulitis.

Special contra-indications

The patient must be questioned regarding sensitivity reactions to local applications, particularly antibiotics. If sensitivity exists 1 per cent Cetavlon solution is a useful alternative.

SUPPORTIVE BANDAGING

Indications and contra-indications

Supportive therapy is the most successful treatment for post phlebitic ulcers and many varicose ulcers it may be used in conjunction with the other treatments described above There are no special contra-indications.

EXCISION AND GRAFTING

Indications

When rapid healing of an ulcer is desired excision and grafting of the ulcer bed is indicated The procedure may be used in association with other measures, such as stripping of superficial varicosities or deep vein ligation designed to improve venous efficiency of the limb

Special contra-indications

The operation should not be performed unless the patient is co-operative enough to persist with long term bandage or stocking support in the post-operative period

Pre-operative preparation anaesthesia

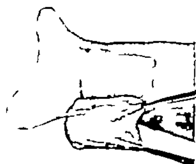
The ulcer should be sterilized as above General anaesthesia is used.

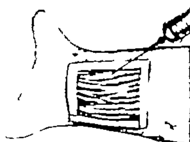
TECHNIQUE

STERILIZATION OF ULCERS

Placing of gauze cover

1 The ulcer is covered with a double layer of dry gauze. This is overlaid with oiled silk and sealed at the edges with tape or adhesive.





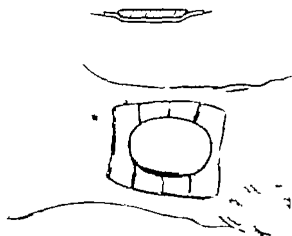
The injection

2 Streptomycin solution (1 per cent) sufficient to saturate the gauze, is injected daily under the oiled silk for 8 days. The patient should remain in bed during the treatment period.

SUPPORTIVE BANDAGING

Ulcer covering

3 The ulcer is covered either with a layer of vaseline gauze or a zinc-oxide strapping For deep ulcers a sorbo-rubber pad is superimposed on the primary dressing



The bandage

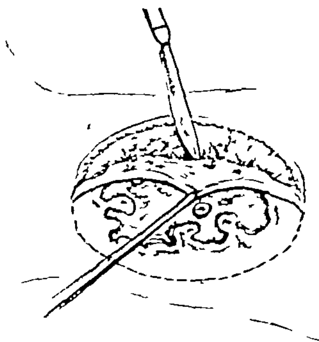
4 Bandaging with heavy-web (one-way stretch) commences at the forefoot the bandage should include the heel and the whole of the lower leg below the knee The ulcer is re-dressed once or twice weekly until healed following healing an elastic stocking should be fitted and worn continuously during the day



EXCISION AND GRAFTING

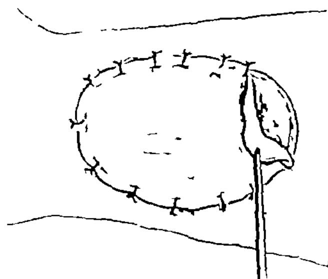
Area of excision

5 A wide excision of ulcer and pigmented surrounding skin should be made including the fibrous base of ulcer together with periosteum or cortex of underlying bone if this is involved. Absolute haemostasis must be obtained by application of pressure by warm saline packs. The large feeding veins in the base and fringe of the cavity may need under-running or ligation with catgut.



Application of skin graft

6 A split-skin graft is applied in sheet, and covered with vaseline gauze and saline-moistened cotton wool. A firm crepe bandage should be applied.



POST-OPERATIVE CARE AFTER ULCER EXCISION

The operation field should be re-dressed in 5–7 days time when tethering sutures are removed. The patient should remain recumbent until the whole area is completely epithelialized, and the leg supported by web or heavy crepe bandage in the immediate post-operative period. The support may eventually be replaced by an elastic stocking

[*The illustrations for this Chapter on Gravitational Ulcers were drawn by Miss Dorothy Davison.*]

PHLEBOGRAPHY

R. P JEPSON F.R.C.S

Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

PRE-OPERATIVE

ASCENDING PHLEBOGRAPHY

Indications

The main value is to exclude or confirm thrombosis or varicosity of the deep venous system when this is in doubt following clinical assessment. A certain amount of indirect information concerning the functional capacity of the venous system can be obtained by special techniques. Many variations in the technique of phlebography have been described. It is preferable, when indicated, to perform an ascending phlebogram and at the same procedure assess the venous pressure changes on standing and exercise. This enables the surgeon to make both an anatomical and functional assessment of the limb. Retrograde phlebography does not, in my opinion, add any further anatomical information and cannot be combined with a direct functional interpretation.

Special contra-indications

The procedure should be avoided in the presence of sepsis, recent thrombosis and in patients with a "thrombotic" tendency such as thrombo-phlebitis migrans and thrombo-angiitis obliterans. Sensitivity to the contrast medium should be excluded by a test dose of Diodrast 35 per cent 0·5 ml. intravenously 30 minutes before study commences. Adrenaline should be available in case of sensitivity reactions.

Anaesthesia

For ascending and upper limb phlebography no anaesthesia is required. For descending phlebography general or local anaesthesia is preferable.

Supplementary techniques

A cuff may be placed in the supra-malleolar region and inflated to 60 mm. Hg before commencing injection. This is thought by some to help to direct the dye into the deep venous system.

A "Valsalva" manoeuvre may be performed immediately before the films are taken. This causes a retrograde flow of venous blood with closure of valves and indicates the presence or absence of valvular efficiency.

Under a bleb of local anaesthetic a length of polythene tube (0·5 mm. diameter) introduced into the dorsal foot vein enables functional efficiency of venous system to be recorded by measurement of standing and exercise venous pressure prior to performance of phlebogram (Boyd and his colleagues, 1953)

DESCENDING PHLEBOGRAPHY

Indications

These procedures are designed to assess the valvular competence of the femoral vein but in the writer's opinion these tests add nothing of value to the information derived from ascending phlebography

Contra-indications and anaesthesia

Descending phlebography should be avoided if groin sepsis or lymphadenitis is evident. General or local anaesthesia is required.

Additional technique

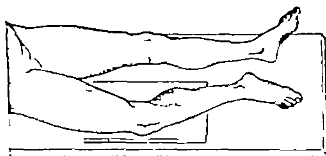
An alternative method is to perform descending phlebography with the co-operative patient standing erect and a casette mounted vertically behind the part of leg to be studied. The distended femoral vein is then punctured percutaneously and 15-20 ml of Diodrast slowly introduced. At the end of the injection the patient performs a "Valsalva" manoeuvre and the film is taken. Where the valves are incompetent the dye is thrust by the transmitted pressure into the calf. If the valves are competent they are "ballooned" in the thigh.

The method gives no information which is not obtainable by ascending phlebography

TECHNIQUE

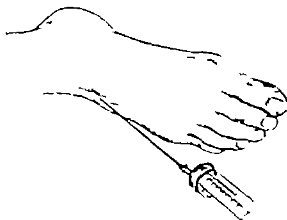
ASCENDING PHLEBOGRAPHY

Position of patient



1 The patient lies horizontally the leg to be studied being abducted at the thigh, externally rotated and flexed to 60 degrees at the knee. A casette is placed under the leg at the appropriate level. The contra-lateral leg is abducted away from the area of radiation A portable x-ray machine gives adequate penetration.

The injection



2 Diodrast, 20 ml. of 35 or 50 per cent, is introduced slowly over at least a 1-minute period into a superficial vein on the dorsum of the foot. At the end of injection the patient holds his breath and the film is taken.

Serial films may be obtained over the next 1-2 minutes if the leg musculature is not contracted or massaged. At the termination of filming the leg is elevated and actively moved in order to eliminate the dye. The investigation may be repeated after 30 minutes if the first series is not satisfactory

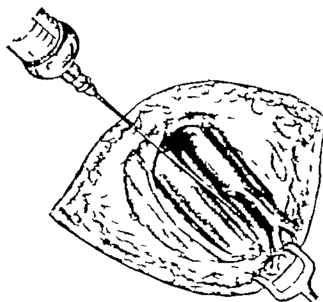
DESCENDING PHLEBOGRAPHY

The patient is tilted so that the legs are 80 degrees below the horizontal. An x-ray casette is positioned behind the lower two-thirds of the thigh and behind the knee.



The incision

3 A transverse incision about 8 inches long and 1 inch below the inguinal ligament, centred over the femoral vein, is used. The internal saphenous vein is isolated and traced through the deep fascia to expose the superficial femoral vein



The injection

4 Diodrast, 20 ml. of a 35 per cent solution is injected slowly over a period of 1 minute into the superficial femoral vein, with the needle pointing distally At the end of injection the film is taken.

Where the valves have been destroyed or rendered incompetent the dye will run back into the popliteal region. This may also occur in perfectly normal veins.

Closure is effected by approximating the deep tissues with catgut. The skin should be sutured without strain

[Illustrations 1 2 and 4 for this Chapter on Phlebography were drawn by Miss Dorothy Davison and Illustration 3 by Miss Helen MacArthur]

Reference

Boyd, A. M., Catchpole B N., Jepson R. P and Rose S S. (1953) *Ann Surg* 138, 726.

DEEP VEIN LIGATION

R. P Jepson, F R C.S.

Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

PRE-OPERATIVE

Indications

Division of the popliteal or superficial femoral veins was advocated by Bauer (1952) and Linton (19 relief of pain and ulceration associated with the valvular incompetence subsequent to a deep venous t (post-phlebitic syndrome) By this means they hoped to interrupt the unbroken column of blood from heart to the ankles and redirect the venous return through supposedly competent collateral vessels. Resul operations have proved less effective in other hands (Boyd and his colleagues, 1958) and have been abandoned for the treatment of the post-phlebitic syndrome.

A further and still practised use for deep venous ligation is in the treatment or prevention of recurrent p emboli which arise from the deep venous system of the lower limb Ligation of the superficial femoral v prior to or coincident with a major operation has been used on selected patients, who because of ag disease, associated neoplastic lesions or previous thrombo-embolic history are thought to be unduly susc the complication of pulmonary embolism It is generally agreed that this relatively minor procedure wh done under local anaesthesia should always be performed bilaterally

Reported statistics (Allen, 1949) indicate that the incidence of embolism, minor or fatal, is not howeve ably lessened by the routine use of such prophylactic surgery and it has never found much favour in Gre Ligation of the common femoral vein should never be performed as it invariably results in severe limb oe ulceration. In the writer s opinion the only reasonable indication for deep vein ligation at the prese recurrent pulmonary emboli which are not controlled by anticoagulants or which occur in a patient in w coagulants are contra-indicated. A patient with a recent history of bleeding from a peptic ulcer wo example of the latter category The operation should be limited to the division of the superficial femora should be performed bilaterally It is unlikely that marked leg oedema or ulceration will follow this proce

Special contra-indications

When the operation is performed in the treatment of pulmonary emboli rectal tenderness, palpable t of the femoral feins distended and engorged inferior epigastric veins may indicate thrombo-phlebitis pr the superficial femoral vein.

Gross local sepsis and excessively prolonged coagulation time from previously administered anticoag out the procedure

If the operation is used for the treatment of the post-phlebitic syndrome then marked inguinal lymphad to a leg ulceration should be controlled prior to operation.

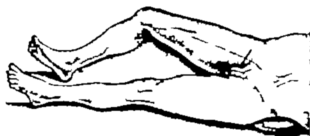
Pre-operative investigations, anaesthesia

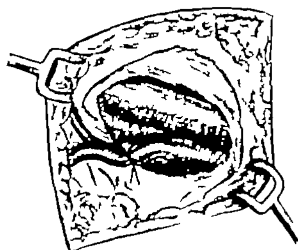
When division of the superficial femoral or popliteal veins is being considered for the post phlebitic s phlebographic and venous pressure studies should be performed in the affected leg in order that the ana function of the deep and superficial veins may be ascertained. General anaesthesia is advisable for the low l the superficial femoral vein.

THE OPERATION

Position of patient

1 The leg is abducted, externally rotated and flexed at the knee with a sand-bag under the contra-lateral buttock.





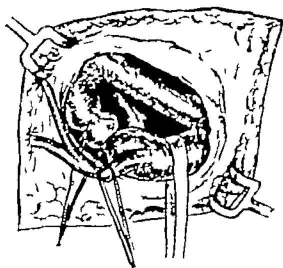
SUPERFICIAL FEMORAL VEIN LIGATION

Isolation of internal saphenous vein

2 A transverse incision 4 inches long and approximately 1 inch below the inguinal ligament is required. The internal saphenous vein is isolated and if incompetent is dissected and ligated as for Trendelenburg's operation. Proximally the internal saphenous vein is followed through the deep fascia which is incised to demonstrate the femoral artery and vein.

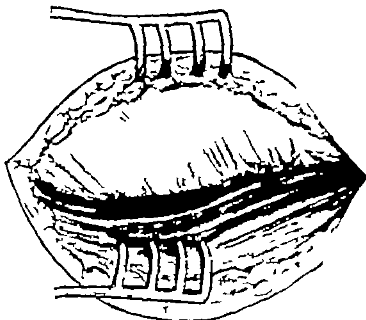
Isolation and division of superficial femoral vein

3 The femoral veins are found to be welded in a mass of perivenous scar tissue and must carefully be dissected free without damage to the laterally placed femoral artery. The lymphatics should be preserved as much as possible. Greatest danger during dissection is to the fragile profunda femoris vein which joins the posterior aspect of the superficial femoral vein approximately 1 inch below the inguinal ligament. The superficial femoral vein is isolated and divided between double ligatures of 000 thread. Care should be taken not to divide the common femoral vein, a mistake which inevitably leads to aggravation of the patient's symptoms. The wound is closed, the deep tissues being approximated with catgut. No drainage is required.



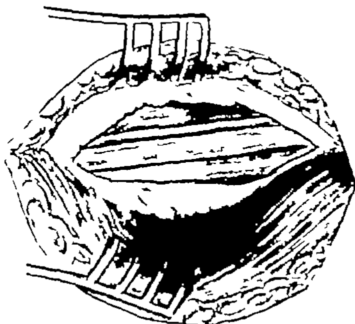
LOW SUPERFICIAL FEMORAL VEIN LIGATION

As the popliteal vein is often not formed until the level of the adductor opening this exposure is preferred to that through the popliteal space



Exposure of fascia

4 A 3-inch skin incision is necessary sited over Hunter's (adductor) canal along the medial border of the sartorius muscle its lower end extending to the junction of the lower third and upper two-thirds of a line joining the adductor tubercle to the mid-inguinal point. The strap muscle is dissected free along its medial edge and retracted medially to expose the thick fascial roof to the canal.

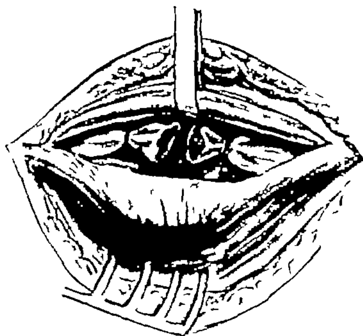


Exposure of femoral vein

5 The fascia is incised in the line of the incision to expose the saphenous nerve, femoral artery and vein. The latter is firmly welded to the artery which lies lateral to the vein at the upper end of the exposure and anteriorly at the lower

6 **Division of femoral vein, closure**

The vein is carefully freed and divided between double 000 thread ligatures at the lower end of the exposure The deep tissues are approximated with catgut. Drainage is not required. Any incompetent superficial varicosities should be ligated or stripped.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Stitches should be removed on the tenth day Owing to the dangers of wound infection from divided lymphatics, penicillin cover for 3–4 post-operative days is advisable. The patient should remain in bed for 10–14 days and should be fitted with a heavy elastic stocking when ambulant

[The illustrations for this Chapter on Deep Vein Ligation were drawn by Miss Dorothy Davison.]

References

Allen, A. W (1949). *Surgery* **26**, 1
Bauer, G (1952). *Société Internationale de Chirurgie* p. 451
Boyd, A. M., *et al.* (1938). *Lancet*, **2**, 118.
Linton, R. R. (1953) *Ann Surg.*, **138**, 145.

INFERIOR VENA CAVA LIGATION

R P JEPSON FRCS

Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

PRE-OPERATIVE

Indications

This operation is rarely indicated possibly only as a final measure in cases of recurrent emboli especially septic arising in the lower limbs and pelvic veins. There are occasional patients who notwithstanding adequate anticoagulant therapy continue to experience repeated pulmonary emboli and others who although still undergoing recurrent pulmonary infarction must submit to further operative procedures which rule out anticoagulant therapy If the emboli are confidently thought to be arising in the limbs bilateral ligation of the superficial femoral veins is indicated if the pelvic or abdominal veins are the source then inferior vena cava ligation may be advised.

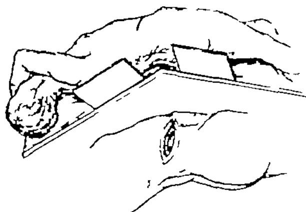
Special contra-indications

The mortality from this procedure varies from nil to 25 per cent in various published series and is related to the severity of the underlying disease rather than to the magnitude of the operation The morbidity arising from inferior cava ligation and subsequent venous hypertension is, however considerable especially where deep venous thrombosis and valvular incompetence pre-exists in the legs. Limb oedema, ulceration and venous" gangrene are frequent sequelae and may greatly incapacitate the patient (Shea and Robertson, 1951) Bowers and Leb (1955) found all of the 83 patients submitted to this operation had some degree of leg oedema and many were further incapacitated by ulceration. These authors consider inferior cava ligation to be contra-indicated in the presence of intestinal obstruction or peritonitis.

Special pre-operative preparation and anaesthesia

Anticoagulant drugs must be stopped and the patient s clotting time should be within normal limits before the operation is commenced. General anaesthesia is used.

THE OPERATION



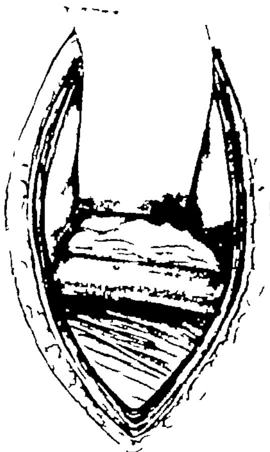
Position of patient

1 The patient lies on the left side with buttock and shoulder supports holding the body at an angle of 45 degrees to the table. The table is broken at the level of the umbilicus to an angle of 80 degrees.



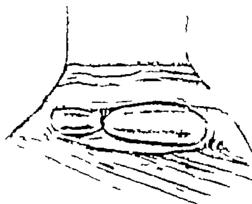
The incision

2 The oblique loin incision extends from below the tip of the right twelfth rib to the edge of the right rectus at the level of the umbilicus. The skin, external and internal oblique muscles are divided, avoiding the subcostal nerve when possible Transversalis muscle and fascia are split with blunt dissector or fingers in the line of incision to expose the peritoneum



3 **Freeing of vena cava**

The peritoneum is brushed off the flank laterally and posteriorly with gauze or finger dissection to the anterior edge of the psoas muscle The ureter and spermatic or ovarian vessels are normally carried forward with the peritoneum. Deep broad-bladed retractors in the medial and upper position of the incision demonstrate the inferior vena cava which is now bluntly dissected free from the aorta and the anterior peritoneal covering Great care must be taken to avoid tearing the lumbar veins or dislodging a thrombus.



4 **Ligation of vessel**

Chinese silk or 000 thread ligature is passed around the inferior vena cava with a blunt ligature carrier Care must be taken not to mistake the right common iliac vein for the vena cava. The muscle is closed in layers with catgut. No drainage is necessary

[*The illustrations for this Chapter on Inferior Vena Cava Ligation were drawn by Miss Dorothy Davison*]

Bibliography

Bowers, R. F., and Leb, S. M. (1955). *Surgery* 37 622.
Shea, P C., and Robertson, R. L. (1951). *Surg Gynec. Obstet.*, 93, 153

EXPOSURE OR LIGATION OF MAJOR BLOOD VESSELS

H. H. G EASTCOTT M.S., F.R.C.S

Surgeon St Mary's Hospital London

PRE-OPERATIVE

Indications

These procedures are indicated in an emergency for local injury and the control of bleeding, or the relief of obstruction. They are also required for the intra-arterial injection of radiographic contrast media, or for very rapid blood transfusion.

The major vessels are most often exposed as part of the elective surgical treatment of lesions such as aneurysm, arterio-venous fistula and localized thrombotic obstruction

Contra-indications

In the first two instances mentioned above no major blood vessel should be exposed if the surgeon's purpose can be served in any other way such as by compression, or by the use of percutaneous injection. An overlying layer of infected or densely adherent tissue should not be dissected through a more normal adjacent site should be chosen for the approach

Special pre-operative treatment

Some patients will have been receiving anticoagulant drugs. It is usually best to stop the effect of these by giving the appropriate antidote for heparin, 10 ml. of 10 per cent protamine sulphate are injected intravenously and for the prothrombin depressor group such as phenylindanedione, 20 mg of vitamin K_1 are given by mouth.

Operative blood loss should be anticipated by arranging for compatible blood to be ready for transfusion before and during operation.

Anaesthesia

General anaesthesia is suitable for most patients, though local infiltration with 1 per cent procaine is very suitable for limb embolectomy in patients with severe heart disease.

Hypothermia is proving to be of great value. It will allow the surgeon to clamp the upper aorta or the carotid artery for long periods with much less risk of visceral or neurological damage developing during this ischaemic phase of the operation. Surface cooling with wet sheets, ice bags and fans, for 1½–2 hours, will reduce the temperature of the anaesthetized adult patient to 28° C below which there is danger of ventricular fibrillation.

Exposure

"The use of wide approach for dealing thoroughly with nerves and vessels needs no defence" (Henry 1946) Flexures may be crossed, muscles or tendons divided, and the abdomen opened to its fullest extent, when reconstructive surgery is undertaken.

THE OPERATIONS

EXPOSURE OF INNOMINATE ARTERY AND FIRST PART OF THE SUBCLAVIAN ARTERY

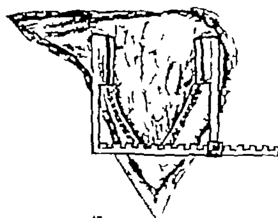
The incision

1 This is centred over the right sterno-clavicular joint (or left for the left subclavian artery) exposing the first two intercostal spaces and the manubrium. A sandbag is placed between the shoulders.



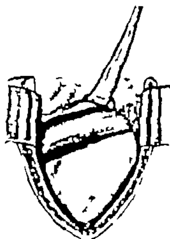
Splitting the manubrium

2 When splitting the manubrium with Sauerbruch's shears (or a Gigli saw over a de Martel guide, between drill holes) the posisternal fat is pushed back and the two halves of the manubrium are separated with a Tuffier's retractor. If necessary, to enable the chest wall to be turned back as a flap, the upper right ribs are divided subperiosteally with shears, and the clavicle with a Gigli saw.



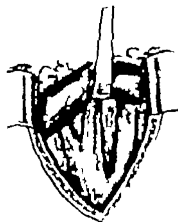
Deep dissection

3 The fat is displaced upwards, and often the anterior pleural fold laterally, to reveal the left innominate vein.



Exposure of the great vessels

4 The great vessels are then exposed by freeing the lower border of the vein, ligating and dividing a few small inferior tributaries if necessary, and gently retracting it upwards. The aorta itself may be mistaken for one of its branches.



EXPOSURE OF THE THIRD PART OF THE SUBCLAVIAN ARTERY

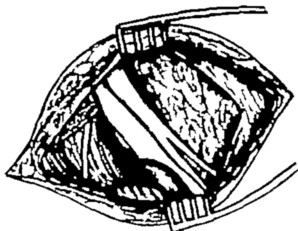
Incision

5 This is made against the resistance of the medial three-fifths of the clavicle with the skin drawn down ½ inch The platysma is divided, the skin is then allowed to slide up again, and the clavicular head of the sternomastoid and deep fascia are divided in the new line of the incision, just above the clavicle.



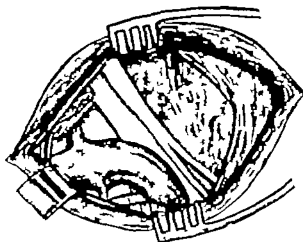
Deep dissection

6 The fatty content of the posterior triangle is then brought upwards and some small veins are ligated. This exposes the scalenus anterior phrenic nerve and brachial plexus. A Mayo's self-retaining retractor is inserted deep in the incision but avoiding the plexus The transverse cervical vessels are divided if necessary unless their collateral function is to be important. The internal jugular vein must be avoided at the medial end of the dissection.



Exposure of artery

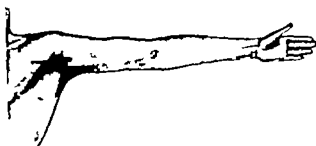
7 Exposure of the artery is now obtained by dividing the scalenus anterior low down, bundle by bundle, with a snipping action of the scissors, the phrenic nerve being retracted medially The divided fibres are swept up and down with a dental cotton swab held in an artery forceps The deepest fibres are aponeurotic. This freely exposes the subclavian artery and the internal mammary origin.



EXPOSURE OF THE AXILLARY ARTERY

Incision

8 With the arm widely abducted the incision is made in the line of the pulsating artery The upward extent will depend upon the site and size of the lesion concerned. The axillary fascia is divided and the fat is swept downwards and medially Some veins and cutaneous nerves may require division at this stage



Dissection

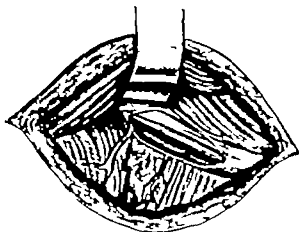
9 The pectoral muscles are retracted forward to reveal the neurovascular sheath. Both muscles, and the clavicle as well, may be divided in the line of artery if necessary as for example in excising an aneurysm or arterio-venous fistula of the upper part of the axillary artery The operation (*see page 66*) for controlling the third part of the subclavian artery can readily be combined with this the shaft, or even the whole of the clavicle, is then excised to give a complete exposure of the whole arterial trunk.



Exposure of the artery

10 The axillary sheath is opened and the vein, medially and the nerves, anteriorly are seen and when separated reveal the artery which can also be identified by following up its subscapular branch proximally

Note—For axillary injuries, arterio-venous fistulas, or aneurysm, the third part of the subclavian artery is usually a preferable site for ligation.



EXPOSURE OF THE BRACHIAL ARTERY IN THE ARM

The incision

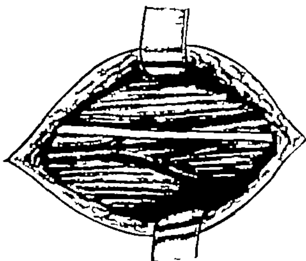
11 The incision is made along the line of the brachial pulse, against the medial surface of the humerus Two inches suffice for a ligation or injection, but much wider exposure will be required for a reconstructive operation. It is useful to support the elbow on a sandbag so that the triceps and its related structures shall fall back out of the operative field.



Dissection

12 The neurovascular sheath is opened. The median nerve, which crosses the artery from lateral to medial as the two structures pass down the arm, is defined and the veins are separated from the artery which may already have branched into its radial and ulnar divisions at this point. The basilic vein enters the sheath here, having perforated the deep fascia. The ulnar collateral artery and medial antebrachial cutaneous nerve lie close to the artery and must not be included in a ligature or clamp

Note —This exposure is used in cases of arterial injury from fractured shaft of humerus, and also for the injection of contrast media, either down the artery or retrogradely into the aorta, through a polythene catheter



EXPOSURE OF THE BRACHIAL ARTERY AT ITS BIFURCATION

The incision

13 A skin crease incision is made with longitudinal extensions up the line of the brachial artery medially and down the brachioradialis laterally Flaps should be cross marked to guide the subsequent placing of sutures



Superficial dissection

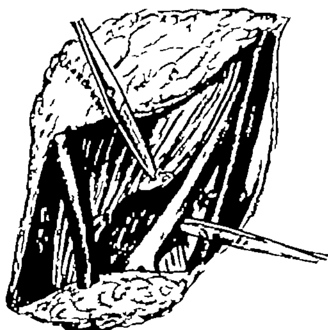
14 The artery is obscured by cubital veins, the deep fascia, and the bicipital aponeurosis. The two cutaneous nerves of the forearm lie deep *to the veins of the medial and lateral ends* of this plane of the incision and should be avoided.



Deep dissection

15 The overlying superficial veins and the bicipital aponeurosis are divided this exposes the artery with its accompanying deep veins, just above its bifurcation which is close to the medial side of the biceps tendon After entering the sheath the operator can easily lift the vessel away from the *venae comites* and from the median nerve, lying to its medial side

A supracondylar fracture fragment may have injured the artery at this point, producing a string-like spasm Local external application of papaverine (1 gr in 8 ml.) will usually abolish this, provided there has been no delay the pulse returns at the wrist within 5–20 minutes. Adventitial infiltration with 2 per cent Xylocaine may have the same effect. This is an operation of the utmost urgency if ischaemic contracture is to be avoided.



EXPOSURE OF THE COMMON CAROTID ARTERY

Incision

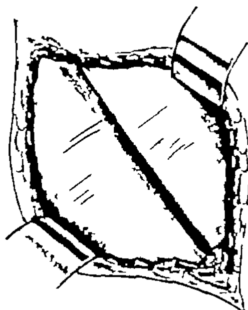
16 With the neck slightly extended, and the head turned a little to the opposite side, a 2½ inch incision is made along the anterior edge of the sternomastoid, with its centre about three fingers breadth above the clavicle. A longer incision in this line ensures greater safety in open operations upon the artery but for simple exposure or ligation an oblique incision is usually preferred.

For a wider exposure of the common carotid artery and internal jugular vein, as in arterio-venous fistula, the incision is extended as shown by the dotted line, dividing the origin of the sternomastoid, as in block dissection of the cervical glands.



Dissection

17 The deep fascia is opened in the same line, and the sternomastoid and infrahyoid muscles are separated from the underlying vascular sheath. This plane of dissection is bloodless except for a sternomastoid branch of the superior thyroid artery

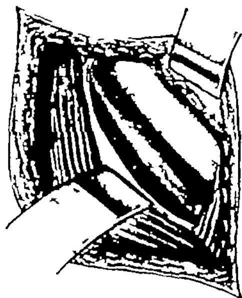


Exposure

18 The sheath is opened above the omohyoid and the vein is well cleared along the whole field. It is then retracted laterally to isolate the artery which has no branches. The vagus lies well back in this gap, and the sympathetic trunk farther still and more medially Lower in the neck the inferior thyroid artery crosses behind the carotid artery

Note —Ligation produces hemiplegia in some, even quite young, subjects owing to defective anastomosis of the cerebral vessels through the circle of Willis The operation should therefore be performed under local anaesthesia and a temporary ligature applied for 5–15 minutes or longer if there is any doubt.

In elderly women the common carotid artery is often dilated and tortuous resembling an aneurysm.

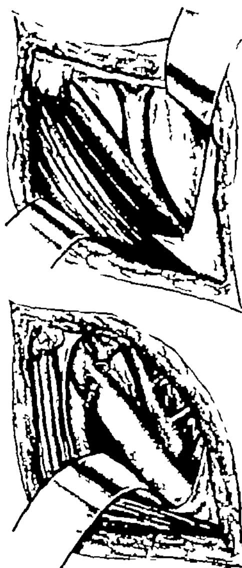


EXPOSURE OF THE INTERNAL AND EXTERNAL CAROTID ARTERIES

Incision

19 An incision is made along the anterior border of the sternomastoid, from just above the angle of the jaw passing downwards for 3–4 inches. For simple ligation a shorter oblique incision in the skin crease is often preferred.





Dissection

20 The sternomastoid is dissected back and the vascular sheath is opened. The common facial vein should be divided between ligatures.

Exposure

21 The carotid bifurcation lies much higher in the neck than is often supposed. The two arteries are close together beneath the angle of the jaw. Branches identify the external carotid, which is anterior and a little deeper. The hypoglossal nerve must not be injured as it crosses the carotid arteries, nor the vagus, superior laryngeal or sympathetic nerves which are behind the bifurcation. The upper part of the internal carotid artery is difficult to expose, for it is deep and is covered for the most part by the ascending ramus of the jaw. The sternomastoid muscle is detached from the mastoid process, which may have to be partly removed by bone nibblers. The digastric muscle is divided, also the occipital artery and the styloid process with its attached muscles. Thus exposes the lateral surface of the artery to some extent.

Note.—The internal carotid may be tied for intracranial aneurysm. Hemiplegia often follows. The external carotid is ligated as a preliminary to radical pharyngo-laryngeal operations.

EXPOSURE OF THE ABDOMINAL AORTA ABOVE THE RENAL VESSELS

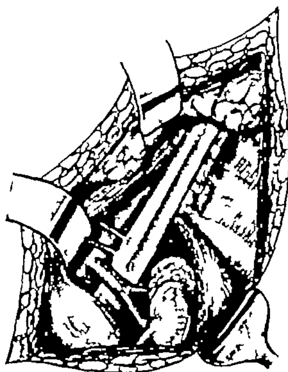


Incision

22 Where the purpose of the dissection is the temporary control of the upper abdominal aorta and its large branches, as in grafting the aorta for lesions closely approaching the renal vessels, a very long mid-line incision may suffice in a thin patient. If there is real difficulty in dissecting the aorta above the level of the left renal vein an oblique extension into the lower left hemithorax must be employed. On its own this is the approach of choice for most formal dissections of the upper abdominal and diaphragmatic aorta. It should be carried across the epigastrium to the right costal margin.

Dissection

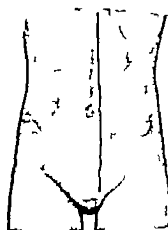
23 The entire contents of the upper abdomen are drawn upwards and to the right after an almost bloodless separation of the spleen and pancreas *from the posterior abdominal wall* The origins of the coeliac and superior mesenteric arteries are readily identified and a temporary tape ligature is applied around each. With aortic aneurysm at the level of the diaphragm, several intercostal branches must be divided. There is danger of spinal cord damage as a result unless the vessels are already occluded by mural clot in the sac. Clamping the aorta at or above this level gravely threatens the cord blood supply but hypothermia reduces the risk of nerve damage



EXPOSURE OF THE ABDOMINAL AORTA BELOW THE RENAL VESSELS

Incision

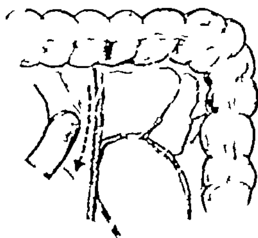
24 A left paramedian incision from pubis to xiphisternum is usually needed when attempting to graft the abdominal aorta. The operator stands on the patient's left. Perfect relaxation must be provided by the anaesthetist.

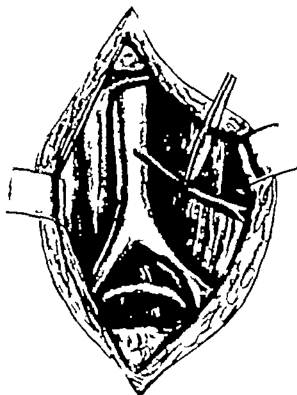


Dissection

25 The transperitoneal approach is preferable unless only the portion of the aorta below the inferior mesenteric artery requires dissection for purposes of clamping under these circumstances, in a thin patient, the extraperitoneal plane is suitable. Otherwise after carefully packing off the intestines, and retracting them with 3-4 broad Deaver's retractors, the posterior parietal peritoneum is incised as shown by the arrow between the duodenum and the upper part of the inferior mesenteric
26 vein This opening is enlarged to expose the aorta up to the point where the left renal vein crosses it, and if necessary down to the bifurcation of the common iliac arteries The inferior mesenteric artery can be divided at source The intestines have been packed off but they may instead be placed in a plastic bag, and are then allowed to hang outside the abdomen, to the right side. This is easier if the mesentery of the whole mid-gut loop is freed by a U-shaped extension of the posterior peritoneal incision, embracing the right colon.

Note—There is considerable risk of ileus after operation. Intravenous feeding and gastric suction are maintained until the bowels have been freely opened. For the same reason wound rupture may occur a careful closure is therefore essential





EXPOSURE OF THE COMMON ILIAC ARTERY

The Incision

27 A lower left paramedian incision is used and must be long if controlling clamps are to be applied to the ends of the artery Simple ligation is possible through a shorter incision, but is seldom indicated unless amputation is already anticipated.





Dissection and exposure

28 The peritoneal cavity is opened, and the left colon is mobilized and is tucked under the right side of the incision it serves as a retractor for the remainder of the intestines. A broad Deaver's retractor is inserted over it, at the line of the pelvic brim. The iliac vessels are soon displayed. The ureter may or may not be taken up with the pelvic mesocolon. It must be identified at this stage, by its peristaltic movements when stimulated

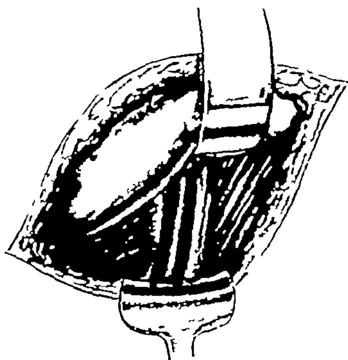
It is possible to clamp the aorta, above its bifurcation, using this approach, and a limited exposure of the right common iliac artery is also obtained. The internal iliac artery is rather inaccessible by any approach. It passes sharply back into the pelvis and is closely related to the great veins. A bulldog clip is unsafe for its control, particularly if the artery is to be divided. The right common iliac artery is exposed through a right paramedian incision in an exactly similar manner except that in this case the right colon is reflected medially to open up the extraperitoneal plane, and to keep the small gut from the field.

EXPOSURE OF THE EXTERNAL ILIAC ARTERY



Incision

29 The classical oblique muscle cutting incision low in the iliac fossa is still the best. The deep epigastric artery at its inner end, should be recognized and preserved.



Dissection

30 The posterior parietal peritoneum is pushed up under the medial edge of the incision and the external iliac vessels are easily found, even if non-pulsatile as they lie on the pelvic brim medial to the psoas muscle The obturator nerve lies beneath the vein in its upper part, and the genito-femoral nerve on the muscle lateral to the artery The ureter often crosses it at its origin.

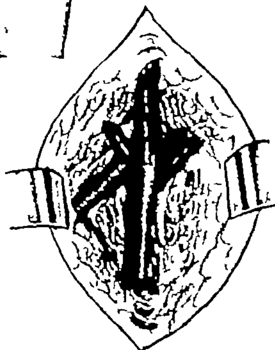
Note—In operations upon the aortic bifurcation poor access to the external iliac arteries is afforded by the transperitoneal paramedian route. It will be useful therefore to employ a separate extraperitoneal exposure, as described above, for the control or anastomosis of the external iliac arteries in grafting or embolectomy procedures in this region.

EXPOSURE OF THE COMMON FEMORAL ARTERY



The incision

31 For local exploration of the common femoral artery a longitudinal incision over its course is preferable to the skin crease incision used in varicose vein operations. This is because of the difficulty of locating and controlling the profunda femoris branch through the more horizontal exposure

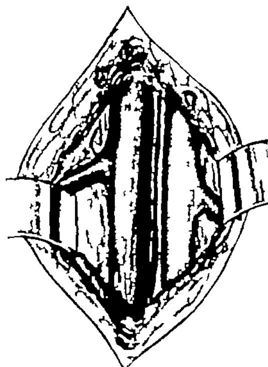


Superficial dissection

32 The sapheno-femoral venous junction and tributaries are first dissected, lifting up the superficial fascia with a mastoid retractor while dividing it with the knife till the veins appear The main terminal trunk of the saphenous vein is freed by dividing the small tributaries and is retracted medially without dividing it.

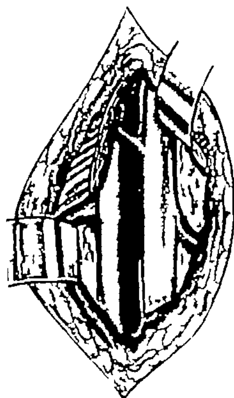
Deep dissection

33 The saphenous opening is now enlarged along the line of the main vessels, one or two small arterial branches being divided at the fascial margins. The femoral sheath is now opened and the artery is cleared. The profunda artery must be located without delay it springs from the back and outer aspect of the common femoral artery often lower than the venous junction. Uncontrollable bleeding from the opened femoral artery is encountered unless the profunda artery is first controlled.



Ilio-femoral junction

34 This can be exposed by an upward extension of the above dissection, dividing the inguinal ligament, but preserving the deep epigastric artery If this is to be done as a planned procedure, the S-shaped incision shown on the previous page is preferred.



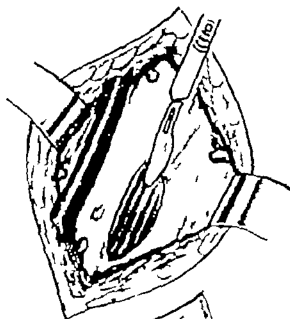
EXPOSURE OF THE SUPERFICIAL FEMORAL ARTERY IN HUNTER'S CANAL

Incision

35 This is made along the line of the sartorius muscle. In cases of obstruction the level will have been identified by feeling for the lowest level of pulsation or by oscillometry or from an arteriogram. The limb should be slightly flexed and abducted, with a sandbag beneath the knee.

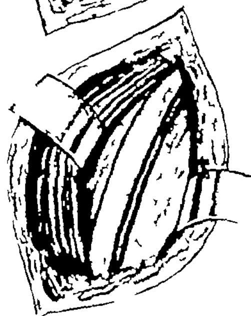
If the femoro-popliteal junction is involved the operation can easily be carried downwards if the patient has been placed in the lateral position, with the affected side beneath and the other limb acutely flexed.





Superficial dissection

36 The saphenous vein is preserved: it may be needed for use as a graft, or to help in reducing congestion in the event of post-operative *hyperaemia or deep venous insufficiency*. The deep fascia is incised and the sartorius muscle exposed.



Deep dissection

37 The sartorius muscle is retracted backwards, and medially and the fascial roof of Hunter's canal exposed and incised. The saphenous nerve is separated from the artery which is then dissected from the underlying vein.

EXPOSURE OF THE POPLITEAL ARTERY



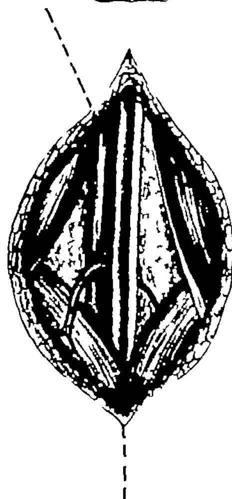
The incision

38 Recurrent ulceration and contraction often complicate the vertical incision which crosses the flexure at right angles. An S-shaped incision with its upper limit medial, avoids this The middle portion should run in the skin crease. A vertical incision is, however satisfactory for exposing the lower portion of the popliteal vessels. Placed between the two heads of the gastrocnemius, it commences below the flexure, and can be extended downwards to expose as much of the upper course of the posterior tibial vessels as may be necessary

Superficial dissection

The short saphenous vein is followed through the popliteal fascia, and the posterior cutaneous nerve dissected aside The fascia, whose fibres run transversely is split longitudinally to reveal the popliteal fat.

Deep dissection



39 The fat is cleared from the two popliteal nerves The popliteal vein is next found, usually via one of its deep tributaries, or perhaps the short saphenous vein The artery lies deeper still. It is crossed by a very constant leash of vessels, mainly some large veins from the medial head of the gastrocnemius they must be divided. The short saphenous vein is preserved if possible.

Extension of exposure

Upward—To reach the femoral vessels, the semi-membranosus belly and tendon of semitendinosus are retracted, or divided, along the line of the artery The tight hiatus in the adductor magnus is also cut through

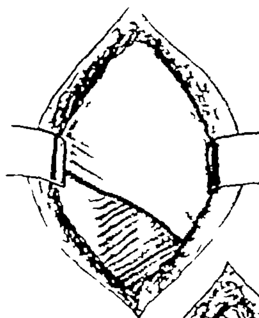
Downward—The posterior tibial artery is readily exposed by splitting the gastrocnemius and soleus fibres in its line, also the fascia which covers the vessels as they lie on the long deep flexors.



EXPOSURE OF THE POSTERIOR TIBIAL ARTERY

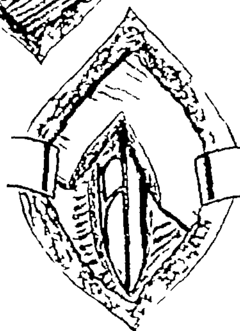
Incision

40 This should be in the middle third of the calf about 8 inches in length, along the line of the medial border of the tibia, but a little back from it, over the muscles.



Superficial dissection

41 The internal saphenous vein is preserved, and the deep fascia incised over the soleus origin from the tibia.



Deep dissection

42 The medial head of the gastrocnemius if in the field is retracted laterally or divided. The soleus muscle is divided in the line of the incision and the thick fascia covering the long deep muscles is exposed. Following this laterally the posterior tibial bundle is encountered. *Note*—An alternative approach, in cases of sural haematoma, is a direct downward continuation of the lower popliteal exposure which separates the gastrocnemii, splits the soleus muscle, and still in the mid-line, gives a more proximal and superficial access, valuable in the control of bleeding

POST-OPERATIVE

This depends upon the regular detailed and careful observation of the local signs and of the patient's general condition. There must be continuity of responsibility Early evacuation of war casualties must not be undertaken unless this is essential.

Posture

To maintain local and general circulatory efficiency is the first consideration Posture is important the head down tilt will help to ensure sufficient cerebral bloodflow in the shocked patient after arterial injury but unless soft tissue swelling of the injured extremity threatens to diminish its blood supply the limb itself should not be elevated above the general body level.

Blood replacement, the management of haemorrhage and thrombosis, and good general nursing care are necessary

Special local signs after arterial ligation

Ischaemia

Pulses—All pulsation disappears from the main artery and its branches below the point of ligation. In the lower limb pulses seldom return even though the limb may survive. In the upper limb pulses may return within hours, though they never equal those in the other limb (Makins, 1919)

The lower level of skin warmth is noticeably higher compared with the unaffected opposite limb When this remains for long above the knee, gangrene is probable

Sensory impairment—Numbness of the skin of the extremity is often misleading some skin sensation will often persist in parts of a limb which are on the same level as patches of established necrosis.

Voluntary muscular contractions—As with sensation movement may remain in a moribund extremity because the dying digits are moved by long muscles which are more proximally sited and are still functioning This test carries the danger of damaging the muscles concerned by unnecessarily increasing their metabolic needs.

Ischaemic muscle contracture—The foot, wrist, or digits become fixed in slight but increasing flexion, with pain on passive extension. This indicates that a serious loss of tissue has occurred in the lower limb gangrene is likely to follow

Haemorrhage

Renewed bleeding produces severe local pain in the wound, and later impairment of the distal circulation of the limb

Attention to associated injuries

It should not be forgotten that bones, veins, and nerves may also be involved in a patient with an arterial injury and these injuries must receive the care which they would demand in their own right. For example, early bone-plating or nerve suture may indicate the need for exploration, at which the injured artery can be dealt with as well.

[*The illustrations for this Chapter on Exposure or Ligation of Major Blood Vessels were drawn by Mr J Wheldon*]

Bibliography

Fiolle, J., and Delmas, J (1921) *Surgical Exposure of the Deep Seated Blood Vessels.* London Heinemann.
Henry A. K. (1946). *Extensile Exposure as Applied to Limb Surgery* Edinburgh Livingstone.
Makins, G H. (1919). *On Gunshot Injuries to the Blood Vessels.* Bristol Wright.

ARTERIAL SUTURE

H H G Eastcott M.S., F.R.C.S

Surgeon St Mary s Hospital London

PRE-OPERATIVE

Indications

Repair of a divided or injured major artery is usually preferable to ligating its ends This applies particularly in the lower limb Trauma, surgical accident, and the radical surgery of cancer as well as elective excision of arterial lesions, require the surgeon to be familiar with methods of arterial suture. The methods illustrated will meet the requirements of the arterial operations shown in other sections. They should be practised in the post-mortem room until the technique is familiar The artery should be excised and the repair tested, using water under moderate pressure.

Contra-indications

Arteries should never be sutured in the presence of infection. Severe compound or crushing injury with loss of the main artery are indications for amputation, not arterial repair A simpler procedure than arterial suture or grafting is also essential in treating battle casualties when tactical considerations demand early evacuation. Some viscera regularly survive arterial ligation (for example, the left colon) and the brachial artery can safely be ligated for injuries not involving its bifurcation, in the otherwise normal subject. Reconstruction of such arteries is therefore not usually necessary

Suture materials and instruments

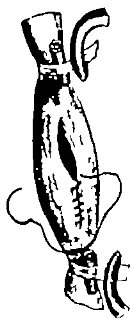
Fine black silk with an atraumatic needle, preferably short, curved and round bodied, is used 0000 for the aorta and iliac arteries, and 00000 for peripheral arteries. A heavier eyed, needle, threaded with stronger silk, is useful for suturing large, diseased arteries. Strabismus scissors, and iridectomy or watchmakers forceps, are useful for trimming the wall of the vessel (see page 82) A small blunt hook will help to hold up the edge of the artery during suture. For the temporary control of small arteries a bulldog clamp with rubber-covered blades is satisfactory larger arteries can be safely held with strong linen tape held by cholecystectomy forceps, with a soft rubber tube interposed to prevent crushing. Most other arterial clamps damage the artery to a greater or less degree. Heparin (500 units per ml) in isotonic saline solution, and papaverine solutions (1 gr in 3 ml. saline solution) should be available for local use in preventing thrombosis and relieving spasm respectively Polythene tubing (size 3–5) with suitable adaptors to the theatre suction apparatus is generally needed as also are irrigating syringes. As is to be expected good lighting is essential.

THE OPERATIONS

LATERAL SUTURE

1 This is a simple method of closing a longitudinal incision in the artery wall, as in embolectomy or thrombo-endarterectomy It has the disadvantage that narrowing of the artery is always produced, and also that the blood pressure tends to force the repair apart, instead of tightening it as does the circular suture of an anastomosis. Where there is loss of substance of the injured wall, resection and anastomosis is preferable.

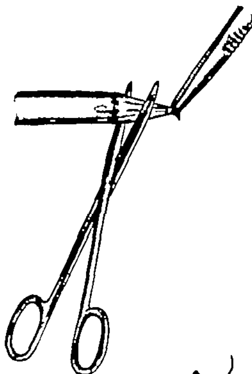
A simple continuous suture is used, rather than an everting stitch which would narrow the artery even more. Bleeding is more troublesome than with circular suture.



END-TO-END ANASTOMOSIS BY A MODIFIED CARREL S METHOD

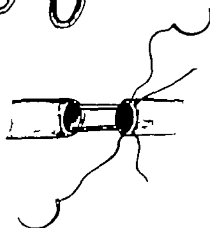
Trimming of adventitia

2 The adventitia is trimmed by drawing it over the cut end of the artery with fine toothed forceps and cutting it close to the end with strabismus scissors. It will then retract beyond the end of the artery thus keeps it from being pulled through the stitch holes into the lumen as the suture is passed, where later it may start a thrombosis.



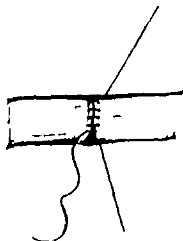
First and second stay sutures

3 The first stay suture is inserted, as an everting horizontal mattress stitch, at the point between the front and back aspects of the anastomosis, and the second at the opposite point on the circumference These two sutures are the most difficult of the whole anastomosis to insert. The operation should never grip the whole thickness of the artery and in particular any trauma to the intima during the manipulations must be avoided.



Continuous suture

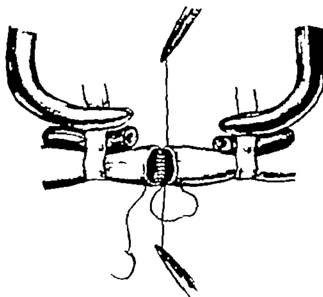
4 A simple continuous suture is placed at intervals of 1–2 mm. according to the size of the artery and a similar distance from the edges of the artery which if its wall is normal, will already have been everted by the two supporting stitches these are held apart with sufficient tension to equalize the diameters of the ends of the artery The continuous stitch is now generally preferred because it does not narrow the anastomosis, and is easy to insert.



Rotation of anastomosis

5 The clamps and the stay sutures are then used to rotate the anastomosis so that its posterior half can be seen and sutured in the same way after tying the suture to the halfway supporting suture.

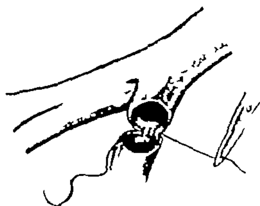
It is often possible so to place the clamps, initially that they may be swung to either side of the wound to allow free access to both sides of the anastomosis without the need for removing and replacing them.



Single stitch method

6 If difficulty is anticipated in rotating the ends of the artery for example near a large bifurcation the same continuous stitch is employed, but with one supporting suture only placed nearest to the operator and continuing this as shown forwards within the lumen, then back over the front of the anastomosis from the outside, till the starting point is reached, at the previously chosen point, in full view

This method is particularly useful in anastomosing diseased arteries which will not allow the smooth pull-up of the Blalock suture (see page 85)

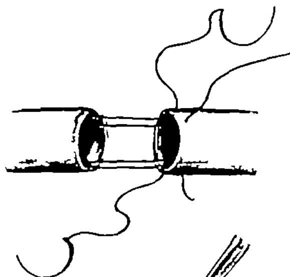


EVERTING MATTRESS SUTURE

This is no longer the standard method of arterial anastomosis It is slow and tends to narrow the anastomosis It does evert the cut edges, and may therefore be chosen in cases where a second, continuous suture is intended to ensure haemostasis for example, in the healthy aorta. It is also a useful method in large arteries for ensuring haemostasis and a firm repair when suturing normal to diseased artery

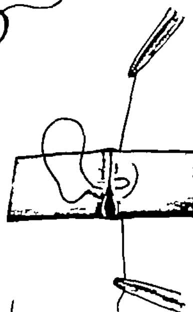
Insertion of everting mattress sutures

7 Two everting mattress sutures (loop on the adventitia) are inserted as shown, and traction is exerted upon them in order to equalize the diameters of the two ends.



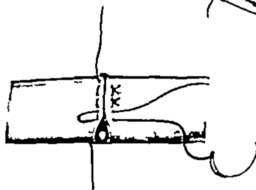
Continuous everting suture

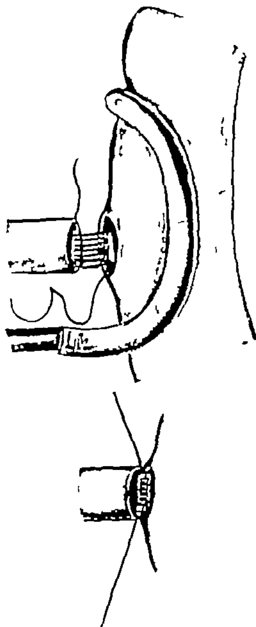
8 A continuous everting suture is then placed, first anteriorly then posteriorly rotating the ends of the artery by (1) swinging the clamps and (2) passing one stay suture beneath and the other across the anastomosis, and then exerting traction as before.



Use of interrupted sutures

9 Where growth of the anastomosis must be allowed for as in coarctation operations in children, interrupted sutures are used.





BLALOCK SUTURE

This is a valuable method of anastomosing normal or thin-walled arteries or veins, either end-to-end or end-to-side or side-to-side, where rotation cannot be achieved, as in coarctation, Blalock's or Potts operations, portacaval anastomoses, and also in the by-pass type of arterial graft.

Continuous everting suture

10 A well-lubricated continuous everting suture (loop on the adventitia) is placed in the posterior half of the two openings its ends are left untied.

Completion of suture

11 When the posterior half is completed the ends are carefully drawn apart, the vessels come together and the suture assumes its final everting form. It is then completed as a normal continuous everting stitch, taking up the tension with each bite on the anterior half of the anastomosis, until the starting point is reached and the suture is tied to its still free beginning

SUTURING THE DISEASED ARTERY

A separate, eyed needle is preferable for suturing the densely sclerotic or calcified artery wall, because it is much stronger than the atraumatic needle. Stronger silk, too may be advisable for the sharper plaques can readily cut an arterial suture

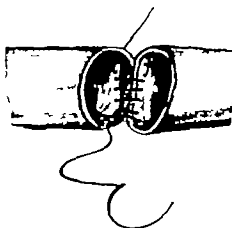
Removal of plaque



12 At the point of section the wall of the artery may split into a thinned media and a thick intimal plaque This tissue must never be dissected free unless its tapering lower point can be clearly and closely seen, divided, and the whole plaque neatly removed. Such loose plaques, unless secured, will be stripped up by the bloodstream as it enters the lower end of the anastomosis, and the artery will thrombose

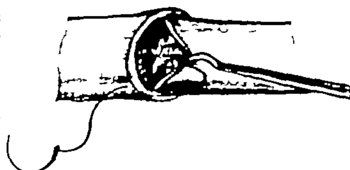
Including plaques in the suture

13 The anastomosis can sometimes be made to include these plaques in the suture. Special care is needed when passing the needle from without inwards as this tends to loosen the plaque. Vice versa, the returning stitch helps to secure it.



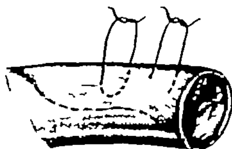
Completion of anastomosis

14 If the other component of the anastomosis is normal, for example a homograft, it may be sutured within the lumen of the diseased end, *using a continuous everting mattress suture.* The blood flow will then tend to push the atheromatous material outwards rather than along and distally



Stitching plaque into place separately from the anastomosis

15 A simple method in the atheromatous medium-sized artery is to stitch the plaque into place separately from the anastomosis, using through and through sutures, over the known site of the defect, from the adventitial aspect. (*See also* by-pass method of arterial grafting, Part VII, page 94.)



PROCEDURE ON RELEASE OF CLAMPS

One distal clamp is released first, to allow the suture to take up slack gently Air is also expelled. Brisk bleeding is quite common on removing the upper clamp Unless a spurting defect is clearly seen the clamps should not be re-applied, but steady pressure is exerted on the anastomosis with a large wad of cotton wool soaked in isotonic saline solution. If this checks the loss the pressure should be maintained for five minutes. The suture line will seldom need adding to if this is done In the rare event of general free bleeding from an anastomosis, a second, continuous layer whether or not the edges are everted, will usually stop the loss. If this fails, a collar of fascia or better still a piece of arterial homograft or pliable synthetic tube is sutured snugly over the anastomosis. If the clamps must be re-applied it is advisable to inject a few millilitres of the dilute heparin solution within the isolated segment to prevent thrombosis and possible embolism

POST-OPERATIVE CARE

Peripheral pulse

A peripheral pulse should be demonstrated to the nurse in charge the skin over it is marked. Its condition is regularly noted it normally increases in force during the first 12-24 hours.

Blood pressure

Blood pressure readings are taken half-hourly or as often as the patient's condition indicates, and are considered together with the pulse chart, when haemorrhage is suspected.

Anticoagulants

Anticoagulants are given only in certain cases of peripheral arterial repair where the state of the vessels suggests that thrombosis is likely to develop and spread, for example, in some operations for arteriosclerosis and after late embolectomy with a marginal circulation.

[The illustrations for this Chapter on Arterial Suture were drawn by Mr J Wheldon]

Bibliography

Carrel, A. (1905). *Am. Med.*, 10 284.
Jahnke, E. J., and Howard, J M. (1953) *Arch. Surg.*, 66, 646.

EMBOLECTOMY

H. H. G Eastcott M.S., F.R.C.S.

Surgeon St Mary's Hospital London

PRE-OPERATIVE

Indications

Peripheral embolism is one of the diminishing number of surgical emergencies in which operation plays an immediate and urgent part. Embolectomy should be performed in all cases where the lower limb is involved to the extent that tissue loss is threatened, even when the patient's general condition is poor. Numbness and patchy cyanosis of the foot are an important warning of the need for operation. Lesser degrees of ischaemia will produce claudication later; therefore emboli occurring in the lower limbs after mitral valvulotomy, or aortic grafting, must be removed as soon as recognized.

Contra-indications

Surgery should not be undertaken where, as very often happens, there are grounds for suspicion that thrombosis, not embolism, is the diagnosis. This also applies to late cases, that is after 10 hours, without anticoagulant treatment, or if ischaemic muscle contracture or visibly thrombosed subcutaneous veins are observed. Others from whom the operation should be withheld are those with a previous history of multiple emboli in whom the recent episode does not threaten to cause gangrene, and to whom claudication would be no disability; those with hemiplegia, and those whose cardiac condition is very poor, for example after coronary occlusion or in the presence of congestive heart failure, particularly if the proposed embolectomy would require a laparotomy. Brachial emboli seldom need removal.

Special pre-operative measures

Heparin, 10 000 units, is given intravenously as soon as the diagnosis is made, and this dose should be repeated in 4 hours if the preparations for operation are not yet complete. The "period of grace" may be lengthened by the use of heparin to prevent propagating thrombosis. Its effect should be allowed to continue during the operation; this is safe, for it can if necessary be eliminated at once by the intravenous injection of protamine sulphate (10 ml. of a 10 per cent solution). Other anticoagulants, which are less certain in their effect and for which there is no immediate antidote, should not be used.

The cause of the embolus should be treated, for example, heparin for coronary thrombosis. In mitral stenosis rapid auricular fibrillation hampers the circulation and may dislodge further emboli. Digitalization is advisable. In thyrotoxicosis a crisis may be controlled by giving a spinal anaesthetic, under which an arteriogram can be obtained if there is doubt about the site of the embolus; the appropriate operation can then be performed while the effect lasts.

The limb should be exposed but not actively cooled, for this may damage the superficial tissues. The remainder of the body is actively heated, to help induce a reflex vasodilatation around the arterial segment blocked by the embolus. Pain is controlled by Omnopon ⅓ gr. or pethidine 100 mg., the injection of which may also exert an antispasmodic effect. Whisky or brandy is given freely to promote vasodilatation and to alleviate the pain.

THE OPERATION

SADDLE EMBOLUS OF THE AORTA

Physical signs in saddle embolus

1 Aortic pulse present.
No pulses below aortic.
Tenderness over the femoral vessels.
Shrunken penis.
Lower limit of warmth mid-thigh often differs on two sides, buttocks may show changes in later stages.
Early ischaemic contracture in legs.



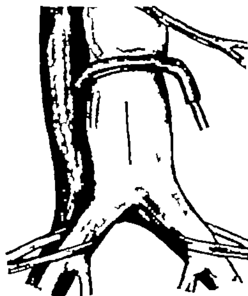
Incision

2 A long left paramedian trans-peritoneal approach is made under general anaesthesia, with adequate assistance and several Deaver's retractors.



Dissection

3 The bifurcation is exposed. Dissection is carried out beneath the pulsating aorta, distal to the origin of the inferior mesenteric artery which must be preserved. An angled aortic clamp (Craaford or Brock) or tape tourniquet is applied. Other tapes are inserted just above iliac bifurcation but not tightened yet. During all posterior manipulations care should be taken to avoid injury to the left common iliac vein. The aorta is incised and the embolus is sucked out with its two iliac "tails" Once free retrograde bleeding is obtained, the iliac controlling tapes can be tightened.

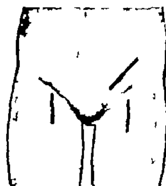


SADDLE EMBOLUS

This is an alternative method suitable for patients who are unfit for laparotomy

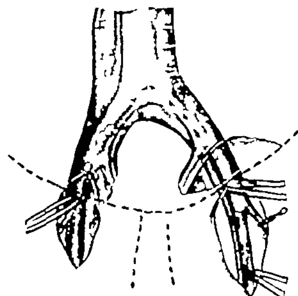
Incisions

4 Under light anaesthesia with ample oxygen, both femoral arteries are exposed and a tape is loosely placed round each, above the profunda branch. On the side with the worse circulation the external iliac artery is exposed and the peritoneum is stripped up from as much of the iliac system as possible beneath the upper edge of the incision.



Procedure

5 A second tape is applied to the femoral artery at the lower end of the thigh wound on the side whose iliac artery is exposed, and a bull-dog clamp is placed on the profunda. The lower two of the three tapes are tightened. An opening is made in the superficial femoral artery on the controlled side and attempts are made within the extra-peritoneal space to milk the embolus down. The opposite femoral artery will generally need a similar procedure to remove its dislodged half of the saddle embolus.



COMMON FEMORAL EMBOLUS

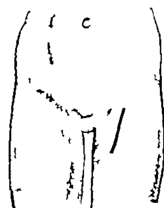
Physical signs in common femoral embolus

6 External iliac pulse bounding
Common femoral absent or weak.
Lower limit of warmth mid thigh
or knee
Popliteal and foot pulses absent.



Incision

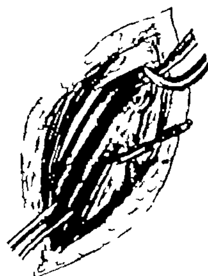
7 A 4-inch incision is made, preferably under local anaesthesia, along the line of the femoral vessels.



Dissection

8 The common femoral artery and branches are exposed. A tape tourniquet is applied on the pulsating common femoral artery or external iliac artery. The profunda artery is cleared sufficiently so that a bulldog clamp can be used securely but this is not applied yet. The artery is incised and the embolus is sucked out, with gentle milking to help dislodge it. The profunda clamp is applied first, when retrograde bleeding is brisk, then the femoral tape after further suction. The artery is then repaired.

Note.—The same method is used for external iliac embolus, except that the upper femoral tape is left loose until the embolus has been brought down out of the iliac artery.



POPLITEAL EMBOLUS

Physical signs in popliteal embolus

9 Popliteal pulse often bounding above embolus, which may be palpable as a tender swelling in upper posterior tibial region.
Lower limit of warmth—midcalf.
Absent foot pulses.



Incision

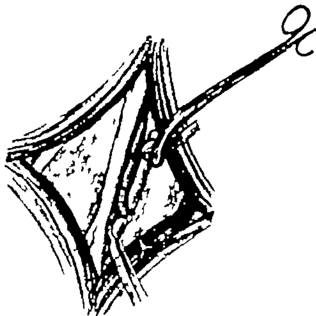
10 This is placed with its centre over the lowest palpable pulsation, or the arteriographic upper limit of the occlusion. With the patient prone, a vertical incision below the skin fold is often suitable; for a higher block the S-shaped exposure is used. For femoro-popliteal embolus an oblique muscle cutting incision centred on the adductor opening is used, with the patient lying on the affected side.

Note.—When the embolus is discovered at the end of a major vascular operation, the limb should be suspended and the exposure made from below to avoid turning the patient.



Dissection

11 The popliteal artery is exposed. Venous tributaries over it need dividing. A tape tourniquet is applied over the pulsating artery and the lower one is left loose until the embolus has been extracted. Free retrograde bleeding confirms this. When in doubt, separate the two heads of the gastrocnemius and insert the index finger down the posterior tibial bundle to confirm the soft condition of the artery or to milk up further thrombus. Also after repairing the popliteal artery confirm that pulsation has returned to the posterior tibial it may not return at the ankle until some time later



POST-OPERATIVE CARE

Local treatment

The limb is supported, level, upon a soft pillow thus avoiding tension within the muscle compartments or pressure on the skin. The cool extremity should be fully exposed. A large bed cradle with the bedclothes folded back to leave its lower end open, prevents undesirable heat insulation and allows frequent nursing observations of the skin temperature and pulses.

The distal pulses may not re-appear until many hours after a successful embolectomy but in the meantime there is always a recognizable and progressive improvement in the circulation to indicate that there is no need for re exploration For example, the lower limit of skin warmth moves down the limb and the patient states that the part feels warmer The oscillometer will often give early positive evidence of a return of pulsatile blood flow to the affected part.

General treatment

The *underlying condition* should be remembered and a physician s help secured if necessary (fibrillation with congestive failure, coronary thrombosis, thyrotoxicosis or bacterial endocarditis) Improving the heart s action in this way increases the perfusion of the ischaemic tissues. Oxygen inhalation may likewise help

Vasodilatation in the extremities is encouraged by (*a*) body heating with electric pads, the wearing of gloves and sweaters, and keeping the room warm and free from draughts and (*b*) the administration of brandy or whisky 2 ounces 4-hourly or adding 90 per cent alcohol, 50 ml., to each litre of an intravenous infusion.

Heparin is indicated in the late case with propagating thrombosis, in whom a doubtful or inadequate retrograde blood flow was noted at operation.

[The illustrations for this Chapter on Embolectomy were drawn by Mr J Wheldon]

Bibliography

Key E. (1936) *Brit. J Surg.*, **24**, 830.
Linton, R. R. (1941). *New Eng J Med* **224**, 189

ARTERY OR VEIN GRAFT

H H G Eastcott M.S., F.R.C.S.

Surgeon St Mary's Hospital London

PRE-OPERATIVE

Indications

Grafting is undertaken for the reconstruction of the aorta and major arteries when they are injured, obstructed, or the site of arteriovenous fistula or aneurysm. It is undertaken however only when direct repair is impossible, on account of the length of the lesion or disease in the adjacent artery wall. Grafting is justified only if the lesion constitutes a threat either to the patient's life or to his livelihood, and if no simpler form of treatment suffices for its relief.

Contra-indications

Arterial grafting should not be employed in the treatment of symptoms which are mild or non-progressive (for example claudication which does not stop a patient working) if there is a good prognosis without operation or in the presence of multiple vascular lesions, or if the patient's general condition is poor from associated causes such as coronary insufficiency Except in emergency it should not be undertaken by those without experience in vascular repair or without an artery bank or store of suitable prostheses close at hand.

Special pre-operative measures

The patient should be seen by a physician if there is any doubt as to his fitness for operation on the grounds of cardio-respiratory or general disease. An electrocardiogram is often advisable Accurate arteriograms are nearly always necessary to the planning of the operation. A Wassermann test may be positive penicillin treatment should then be given by a venereologist and sufficient time (4–6 weeks) allowed for the microscopic arterial lesions to resolve, provided there is no danger in delaying the operation.

Arrangements must be made for compatible blood to be available in the operating theatre—1–2 pints for peripheral arterial grafts, and 2–6 pints for resections of the aorta Apparatus for intra-arterial transfusion should be available A suitable selection of stored homografts or synthetic implants must be available

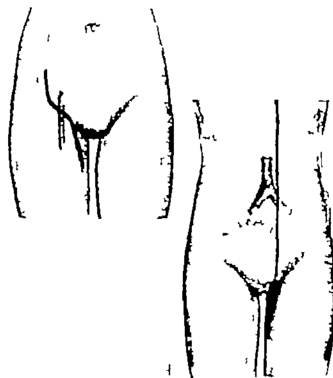
Position of patient

These operations are often prolonged and exhausting for both the patient and the operator The operating position must therefore be planned to give good access with the least possible strain to the patient. Wherever possible the supine position is used. Combined, synchronous operations are sometimes possible by using special lateral positions long portions of the femoro-popliteal trunk may be exposed simultaneously

Lastly in operations for aortic aneurysm above the level of the renal arteries, it is useful to arrange for a second surgical team to take over at a suitable stage in the procedure, for example between excision and grafting

Anaesthesia

For operations on the abdominal aorta, muscular relaxation must be complete A blood pressure chart should be kept, for a dangerous fall may occur when the clamps are removed. The blood transfusion rate should be increased before this stage also noradrenaline (1 250 000) is substituted in the second infusion previously used for the administration of Pethidine and relaxants.



THE OPERATIONS

The method shown is applicable to any of the common situations where a graft is needed. The exposure and dissection should be carried out as shown in Exposure and Ligation of Major Blood Vessels (page 64)

Incision

1 This must be much longer than the lesion concerned, to allow for safe dissection and clamping of the artery above and below it. Careful haemostasis is essential or superficial bleeding may obscure the delicate dissection which is to follow Two incisions may be better than one

Dissection

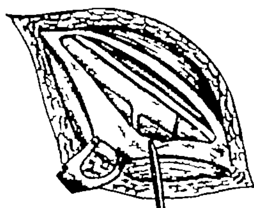
2 A self-retaining retractor is employed in the limbs or the chest.

A careful anatomical dissection is made, with scrupulous haemostasis, so that the graft may be inserted in a clear dry operative field, and its security can be judged when the clamps are removed.

Injury to nearby nerves or to the accompanying vein must be avoided.

All collateral branches are preserved in cases of arterial obstruction until the sites for the anastomoses have been chosen.





AUTOGENOUS VEIN GRAFT

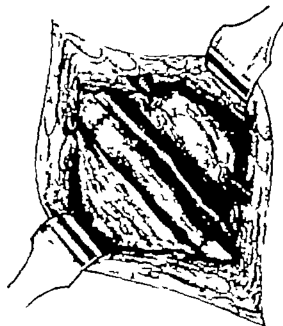
These are only suitable for the replacement of healthy peripheral arteries. For short defects in Scarpa's triangle Weglowski's method (1925) is convenient.

Division, ligation and suture of vein

3 Having exposed the femoral artery the nearby long saphenous vein is ligated and cleanly divided near the lower end of the wound, and this free end is then sutured, end-to-end, to the upper stump of the artery The controlling clamps are then released for a few minutes to stretch and lengthen the vein and also since it is to survive as an autograft, to moisten and nourish its living cells.



4 The clamps are then re-applied the upper end of the vein is divided, brought down and anastomosed to the distal cut end of the artery In operating for thrombotic arterial occlusion the lower arterial clamp need not be applied before this stage, for before being removed the lesion itself acts efficiently in this way with less risk of damage to the patent portion below it than would be caused by a clamp Free autogenous vein grafts must be reversed to avoid valvular obstruction. Orientation is usually easy for the wider end of the vein graft must be sutured to the narrower lower end of the artery

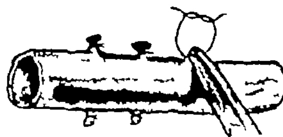


Preparation of the arterial homograft

5 This will have been stored either by refrigeration in a balanced saline solution or by deep freezing at −70 C in solid carbon dioxide or at room temperature in a sealed, evacuated tube after freeze-drying The first is ready for use, but the latter two types must be respectively thawed or re-hydrated.

The branches of the graft are ligated, or sutured if they have been cut short at the time of removal from the donor

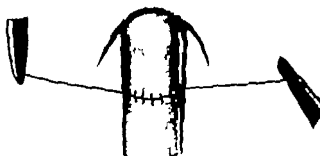
Cloth and other pliable synthetic tubes have the great advantage that they need no such special attention before being sutured into place



6

Upper anastomosis

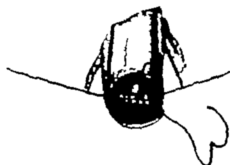
The upper anastomosis is begun as described in Arterial Suture (page 81) the anterior layer first, after freshening and removing the adventitia from the end of the graft and the recipient artery



7

Posterior layer

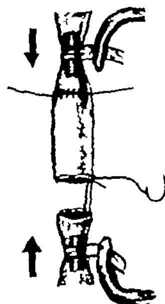
The posterior layer is inserted by turning the graft back over the upper edge of the wound and continuing the same stitch until it meets the first traction suture, to which it is then tied.



8

Lower anastomosis

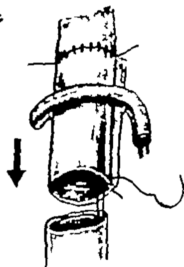
The lower anastomosis must be made under tension or looping and redundancy will develop when the blood is admitted. The graft should be cut across, away from any branch site, to four-fifths of the length of the defect. Tension for this repair is taken up by approximating the clamps controlling the two ends of the artery The posterior layer of this anastomosis is inserted (see page 79) by rotating the ends, by a single continuous suture from within, or by the Blalock stitch (see page 85)



9

Pliable plastic prosthesis

For a pliable plastic prosthesis the tension should be slightly less as it may possess little or no elasticity An aortic clamp can be placed across it to provide tension during the anastomosis. This might damage a homograft.



GRAFTING THE AORTIC BIFURCATION



Exposure

This is as illustrated in Exposure and Ligation of Major Blood Vessels (page 64)

Dissection

10 When thrombosed or aneurysmal the aorta is more or less adherent to its surroundings the duodenum vena cava, ureter and left common iliac vein particularly so they are easily damaged. It is usually advisable to leave in place that portion of the aorta which adheres to the vena cava. In aortic thrombosis the whole vessel may be left in position.

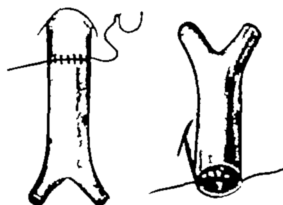
The upper clamp is usually easy to apply after defining the lower border of the left renal vein and its junction with the vena cava. The left renal artery must not be included in the clamp Sometimes two lumbar arteries must be divided to accommodate the posterior blade of the clamp

The lower clamps offer more difficulty for the thin-walled iliac veins are so easily damaged during their separation from the arteries.



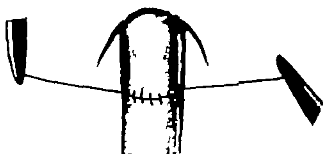
Removal of lesion

11 The lesion is removed as far as may be necessary or possible several lumbar arteries needing ligation and division in the process for they are often patent. The inferior mesenteric artery is tied at its source, unless not involved in the lesion. The left ureter must be avoided.



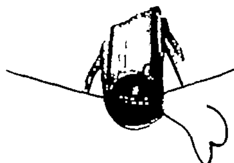
Upper anastomosis

12 The upper anastomosis is performed first (see page 91) Widely spaced sutures are best in the diseased aorta a second layer is often advisable, and sometimes a reinforcing cuff of the graft, if the artery is grossly diseased.



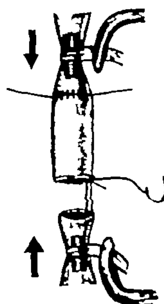
Upper anastomosis

6 The upper anastomosis is begun as described in Arterial Suture (page 81) the anterior layer first, after freshening and removing the adventitia from the end of the graft and the recipient artery



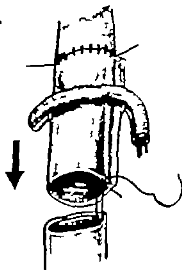
Posterior layer

7 The posterior layer is inserted by turning the graft back over the upper edge of the wound and continuing the same stitch until it meets the first traction suture to which it is then tied.



Lower anastomosis

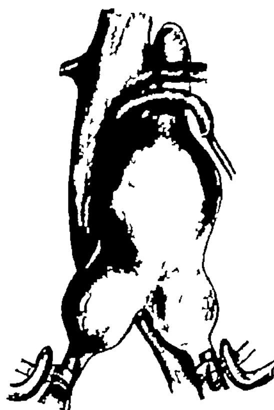
8 The lower anastomosis must be made under tension or looping and redundancy will develop when the blood is admitted. The graft should be cut across, away from any branch site, to four-fifths of the length of the defect. Tension for this repair is taken up by approximating the clamps controlling the two ends of the artery The posterior layer of this anastomosis is inserted (see page 79) by rotating the ends, by a single continuous suture from within, or by the Blalock stitch (see page 85)



Pliable plastic prosthesis

9 For a pliable plastic prosthesis the tension should be slightly less as it may possess little or no elasticity An aortic clamp can be placed across it to provide tension during the anastomosis. This might damage a homograft.

GRAFTING THE AORTIC BIFURCATION



Exposure

This is as illustrated in Exposure and Ligation of Major Blood Vessels (page 61)

Dissection

10 When thrombosed or aneurysmal the aorta is more or less adherent to its surroundings, the duodenum, vena cava, ureter and left common iliac vein particularly so they are easily damaged. It is usually advisable to leave in place that portion of the aorta which adheres to the vena cava. In aortic thrombosis the whole vessel may be left in position

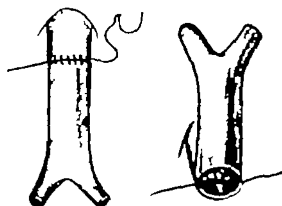
The upper clamp is usually easy to apply after defining the lower border of the left renal vein and its junction with the vena cava. The left renal artery must not be included in the clamp Sometimes two lumbar arteries must be divided to accommodate the posterior blade of the clamp

The lower clamps offer more difficulty for the thin-walled iliac veins are so easily damaged during their separation from the arteries.



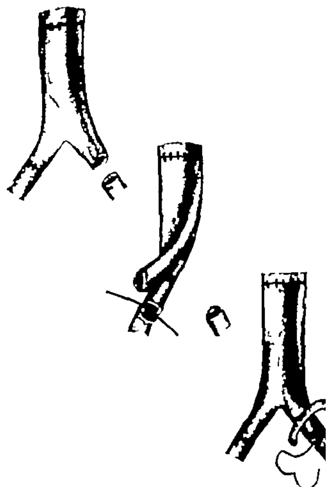
Removal of lesion

11 The lesion is removed as far as may be necessary or possible, several lumbar arteries needing ligation and division in the process, for they are often patent. The inferior mesenteric artery is tied at its source unless not involved in the lesion. The left ureter must be avoided.



Upper anastomosis

12 The upper anastomosis is performed first (see page 91) Widely spaced sutures are best in the diseased aorta a second layer is often advisable and sometimes a reinforcing cuff of the graft, if the artery is grossly diseased.

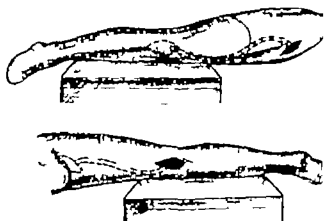


Lower anastomoses

13 The more difficult of the two lower anastomoses is then completed, rotating it to place the posterior layer (see Arterial Suture page 81) The second lower anastomosis is best accomplished by a single continuous stitch starting from the inner side, coming towards the operator on the posterior layer then away from him back to the starting point. If necessary the aortic and the first common iliac anastomosis may be unclamped while the third anastomosis proceeds below a single controlling clamp near the bifurcation.
If the internal iliac is patent it should be embodied in the reconstruction, either by an end-to-side anastomosis of the graft to common iliac or a separate anastomosis with a graft bearing an internal iliac branch.
The posterior peritoneum is then repaired and the abdomen closed.

END-TO-SIDE OR BY-PASS METHOD OF ARTERIAL GRAFTING FOR THROMBOSIS

This operation aims at creating a single large new collateral and unlike the normal or replacement type of graft, it spares all those which already exist, also any patent channels which may remain within the thrombosed portion.

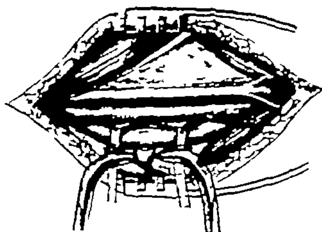


Position of patient for femoral by-pass

14 The lateral position shown permits two operators, working synchronously each to expose a short length of the main artery above and below the occlusion.

Lower dissection

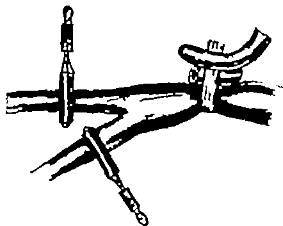
15 The lower dissection is completed, to determine whether the artery is in sufficiently good condition to justify proceeding with the operation for here the lumen is narrower and the atheromatous material easily detached by the restored blood flow



Upper dissection

16 The upper dissection aims at preserving the vital collaterals above the block, using bulldog clips. The segment thus isolated is incised, longitudinally or a very narrow ellipse of the wall removed.

The graft is then passed up through a tunnel in the soft tissues, made with the finger or a fasciatome, and the two anastomoses are made, end-to-side, avoiding tension on the graft. Great care must be taken in the preliminary ligation of the graft's branches for they will be obscured when the graft is in position.



POST-OPERATIVE CARE AND COMPLICATIONS

The nursing staff quickly learn the special features of the care of these patients. These special features are as follows

(a) *The general circulation* (pulse rate and blood pressure readings to be taken at 15-minute intervals during the first 6 hours) should be watched with regard to possible haemorrhage.

(b) *The local circulation* (pulses in the operated limb colour and skin temperature of extremity compared with normal region) will give warning of possible thrombosis of the graft, or embolus from it.

Secondary exploration

This is rarely needed for haemorrhage, but when it is the urgency is great. The graft is quickly exposed and any source of bleeding is packed while a very rapid blood transfusion is given, into the exposed main artery if necessary The bleeding point is then dealt with this is more likely to be from an untied branch on the graft or the host artery near it, than from the anastomosis.

Secondary haemorrhage occurs if a graft becomes infected, as for example when an aneurysm which is partly or completely irremovable must be left in place, perhaps to suppurate in direct relation to the graft. The chance of this complication may be reduced by using a pliable prosthesis in such cases instead of a homograft.

Thrombosis or embolism are commoner The distal pulse disappears soon after the release of the clamps. Most re-explorations for these complications are decided upon while the patient is still in the theatre, particularly with embolus. The incidence of popliteal embolus after aortic grafting for aneurysm is quite high.

In either case re-exploration is advisable and the pulses indicate the site to be explored (*see* page 84) If none is felt the graft itself should be inspected and thrombus removed if present. If the cause is a faulty or twisted anastomosis it should be excised and re-made.

Wound rupture and infection

Rupture of the abdominal wound occurs as a result of paralytic ileus. Its incidence is reduced by the use of deep tension sutures, and a preventive gastric suction regime, with parenteral feeding until flatus is freely passed.

Superficial wound infection is sometimes seen in the limb cases as a result of underlying haematoma and tension on the sutures. It can be prevented by efficient drainage or by the use of the delayed primary suture method and by avoiding flexure-crossing incisions.

[*The illustrations for this Chapter on Artery or Vein Graft were drawn by Mr J Wheldon*]

Bibliography

Rob, C. G Eastcott, H. H. G and Owen, K. R. (1950). *Brit. J Surg.*, **43**, 449
Weglowski, R. (1925) *Z Chir.*, **52**, 2241

ARTERIOGRAPHY

JAMES BULL, M.D., F.R.C.P., F.F.R.

Radiologist St George's Hospital London Radiologist National Hospital for Nervous Diseases London

PRE-OPERATIVE

Introduction

Only the percutaneous method of injection will be described. It is now so well established that the open operation should never be considered unless very special circumstances exist.

CEREBRAL ARTERIOGRAPHY

Four different arteries may require puncture (1) common carotid (2) internal carotid (3) external carotid and (4) vertebral. The procedure is basically the same for each, but only two will be described—the common carotid and vertebral

Indications

The indications include (1) subarachnoid haemorrhage (2) the confirmation of (*a*) thrombosis or (*b*) embolus of a major cerebral vessel (3) the confirmation of the diagnosis of an aneurysm when bleeding has not occurred and (4) the confirmation or refutation of the presence of (*a*) intracerebral haemorrhage or (*b*) angioma (which has not bled into the subarachnoid space and thus is excluded from group (1))

It must be appreciated that only the more gross lesions situated on major vessels can be demonstrated.

Cerebral angiography is also widely used for the localization and pathological diagnosis (by the vascular pattern or its absence) of intracranial space-occupying masses. Except for the specialist these lesions are probably better located by ventriculography

Special pre-operative preparation

It is advisable to starve the patient for about 4 hours The contrast medium generally used (diodone) occasionally causes nausea and even vomiting in a small minority of patients.

If the intracranial pressure is thought or known to be raised, alkaloids should not be used as it is well known that they may further depress the respiratory centre Pethidine, 50–100 mg half an hour before the investigation has been found satisfactory If there is no question of raised intracranial pressure a combination of drugs such as Nembutal and Omnopon is recommended.

Anaesthesia

When necessary Pentothal, gas and oxygen are recommended as a suitable form of anaesthesia

VERTEBRAL ARTERIOGRAPHY

Indications

Vertebral arteriography is usually a painful process since the needle point almost inevitably strikes a nerve leaving the exit foramen of the cervical spine (The vertebral artery bears a very close relation to the nerve in the exit foramen.) Thus general anaesthesia should be used as a routine for this procedure

General anaesthesia should also be used if the patient is a child, in certain cases where the patient cannot co-operate as a result of blurring of the mental faculties, or in an unduly apprehensive patient.

Gaining the co-operation and confidence of the patient

If the operation is to be performed on the conscious patient the steps of the procedure must be explained to him. He should be told that a local anaesthetic will be injected into his neck. Apart from a skin prick this will not be painful. Shortly after this he will experience a sensation of pressure and when the needle is introduced into the artery it will be transiently painful. The arterial wall cannot be fully anaesthetized

Next, during the injection of the contrast substance, he will experience a feeling of heat running up to his head and usually focusing behind the eye, around the ear or teeth of the injected side. Any or all of these regions may feel hot depending on whether the common carotid, external or internal artery is injected. This feeling of heat will only continue for a few seconds and it should be explained that it is vitally important that the patient should not move his head during this time as any movement will blur the radiographs which will be taken while the sensation of heat is being experienced.

Procedure during operation

The radiographic team should consist of two members. One member stands by to remove the casettes after each exposure and the other member to operate the exposure button at the appropriate command.

A counterbalanced lead-rubber protective screen is lowered round the patient's neck, after the needle has been inserted in the artery and before the injection is commenced, to protect the operator and assistants from radiation.

Contrast medium

The contrast medium, 10 ml. of 85 per cent diodone, should be prepared previously by a second nurse assistant. This nurse should supply the first nurse assistant with the appropriate solutions in a 10-ml. syringe at the commencement of the injection

Should the patient move his head or should some other misfortune occur during the procedure it may be necessary to repeat the injection. Doses of up to 60 or 80 ml. of the contrast medium may be injected in 10-ml. doses without harm to the patient. It is permissible to use 42·5 per cent contrast medium (by mixing equal quantities of 85 and 60 per cent) if the common rather than the internal carotid artery is injected. A solution stronger than 42 5 per cent is not recommended and should not be necessary except in special circumstances.

VERTEBRAL ANGIOGRAPHY

Technically the procedure is almost identical to carotid angiography

Anaesthesia

A general anaesthetic is advisable as already stated. No local anaesthetic is necessary

Contrast medium

A strength of more than 85 per cent of the contrast drug should not be permitted in vertebral injections as the medulla oblongata is probably more sensitive to the drug than any portions of the brain supplied by the internal carotid artery It is also advisable to inject the contrast substance more slowly as it is very easy to move the needle point out of the arterial lumen particularly if injection is rapid

The injection

The general procedure is otherwise the same as for carotid arteriography It is customary to make two injections, one for a series of lateral radiographs, and the other for antero-posterior radiographs. In order to project the heavily calcified petrous bones away from the plane of the vertebral arterial tree it is advisable in the antero-posterior projection to tilt the x-ray tube so that the rays are directed about 85 degrees towards the feet.

FEMORAL ARTERIOGRAPHY

Apart from the cerebral arteries there is seldom any indication to outline peripheral arteries other than the femoral This vessel is probably the easiest of all to puncture and little trauma is likely to occur if the operation is not entirely satisfactory It is therefore the artery of choice for the novice to puncture

Indications

Any form of suspected vascular disease in the lower limb The commonest condition in which the investigation is used is a suspected thrombosis of the superficial femoral artery in the adductor canal This condition is very much more frequent than is generally supposed and severe symptoms occur *only* when the collateral circulation is inadequate

Special pre-operative preparation

In general it is the same as for cerebral angiography Unless special circumstances exist it should always be possible to carry out the procedure under local anaesthesia

Position of patient

The patient is laid on an ordinary x-ray table in the supine position Large casettes covered by fixed grids are placed under the limb to be investigated. The upper edge of the more cranially situated casette should be just below the iliac crest. For most purposes it is unnecessary to take phlebograms so that no changing of films is required as in cerebral angiography

Instructions to the patient

It is explained that a local anaesthetic will first be given and then the artery will be punctured. Shortly afterwards the injection will take place. The patient is told that a sensation of heat will be experienced, passing like a wave down the thigh and calf and finally down to the toes. This heat will be rather unpleasant but it is essential that he keeps the limb from moving (It is advisable to make an assistant steady the foot.) Finally it should be explained that the sensation of heat is very transient and that the patient should note his sensations and describe them afterwards. It is of some value to know how far down the limb the heat is experienced. When the peripheral circulation is severely damaged the heat may not be felt beyond the ankle or even mid-calf.

Contrast medium

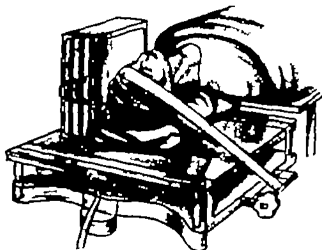
Since a longer vessel has to be opacified one uses a greater quantity of contrast substance 20 ml. are found to be a sufficient quantity The strength should be about 42 5 per cent, or a mixture of equal quantities of 85 per cent and 60 per cent, two commonly marketed strengths. A more dilute contrast medium may not cast an adequate shadow and a more concentrated medium has two disadvantages Firstly the sensation of heat may be so intense that the patient cannot keep his leg still during radiography and secondly a concentrated medium tends to produce spasm of the arteries which is potentially dangerous to a limb with an already diminished blood supply

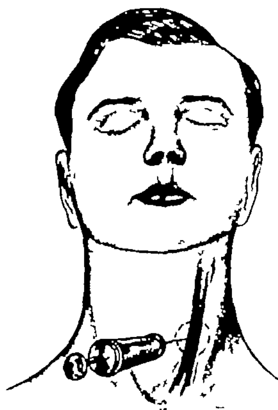
THE OPERATIONS

CAROTID ARTERIOGRAPHY

Position of patient

1 The skin of the neck is cleaned with an appropriate antiseptic. The patient lies supine, preferably on a fairly comfortable stretcher trolley. His head lies beyond the end and should rest in an extended position on the skull x-ray table. A special binder retains the head in position. The patient is then covered with sterile towels from the neck downwards. Note the casette box to the left of the patient's head. It carries three casettes loaded behind a stationary grid. The three casettes are for (1) arteriogram, (2) early phlebogram and (3) late phlebogram. The x-rays are projected horizontally and centred at the upper tip of the patient's ear. (A home-made wooden casette box is not difficult to construct.)





Technique of local anaesthesia

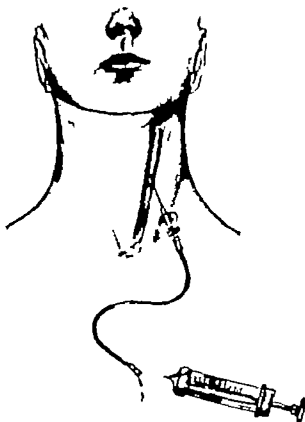
2 The pulsation of the carotid artery can usually be felt quite easily between the larynx and the medial edge of the sternomastoid muscle. Its position varies a little from patient to patient. In patients with long thin necks and in children the vessel is liable to be rather mobile. Having found the vessel by palpation the operator punctures the overlying skin and infiltrates it with a little 2 per cent Novocain. The needle is then introduced more deeply to about 1.5–2 cm. and Novocain is infiltrated laterally, medially and superficially to the vessel. About 4 ml. should be sufficient.

The arterial puncture

Apparatus fixing of artery

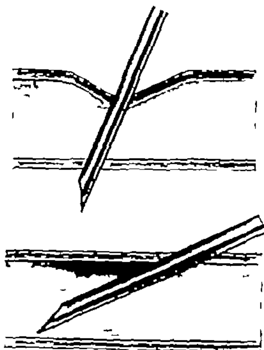
3 After a short interval the arterial puncture is made A special needle of appropriate length and bore is used, which is attached to a transparent vinyl plastic connecting tubing and thence to a 20-ml. syringe containing normal saline solution The assistant (nurse) holds the syringe and when the needle point punctures the skin the syringe is detached. (The saline solution within the tubing does not flow out on account of surface tension)

The operator standing to the right of the patient's chest, palpates and fixes the artery with the index finger of the left hand. Some operators prefer to fix the vessel between the index and middle fingers. Mobility of the artery may be reduced by extending or even hyperextending the patient's head.



Technique of puncture

4 When the vessel is felt on the needle point, the operator advances the needle about 1 cm. with the object of transfixing the artery The needle is then slowly withdrawn, millimetre by millimetre at the same time depressing the handle end of the needle until the point is felt "flicking" into the vessel. This "flick" is not always felt by the operator but is a good sign that the needle point is surely in the lumen of the vessel However a constant watch is kept on the plastic tubing and a good flow of blood shows that the needle point is within the artery The assistant then re-attaches the syringe and injects saline solution slowly to prevent clotting The counterbalanced lead-rubber protective screen is then placed in position (see Illustration 6) The radiographic team should now be completely ready



The injection

5 All is now ready for the injection of the contrast substance. The first assistant removes the saline solution-containing syringe and replaces it with the contrast-containing syringe. She then injects fairly fast (over about 2–3 seconds) the patient being warned of the impending sensation of heat, and the radiographers finally alerted. After about 6 ml. have been injected the operator gives the command and the arteriographic picture is taken. About 2 seconds later he repeats the command for the early phlebogram and after another 2 seconds repeats it again for the later phlebogram.

The saline solution-containing syringe is then re-attached and slow injection is made until the radiographic staff have moved the x-ray tube into a suitable position for taking another series of pictures at right angles to the first (A.P.) It is customary to take the lateral series first and follow with an A.P. series.

When all is prepared again a second injection of the contrast substance is made, the patient being again warned of the sensation of heat.

Before completing the operation the operator should satisfy himself that his films show all the information available and that he does not need to take further projections. He then removes the needle having warned the patient that it will hurt momentarily. After the needle has been removed firm digital pressure (which is somewhat painful) is applied for about a minute. By this time any oozing should have ceased and a firm Elastoplast dressing is applied for about 24 hours.

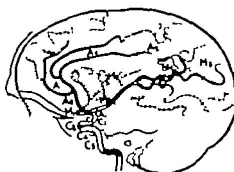
There should be no after effects, but the patient is advised to rest in bed for the remainder of the day

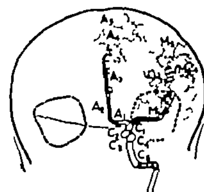




Diagrammatic representation

6 The illustrations show lateral and antero-posterior views of internal carotid arterial tree showing cranial portion of internal carotid, anterior and middle cerebral arteries. C= internal carotid artery. A = anterior cerebral artery. M= middle cerebral artery



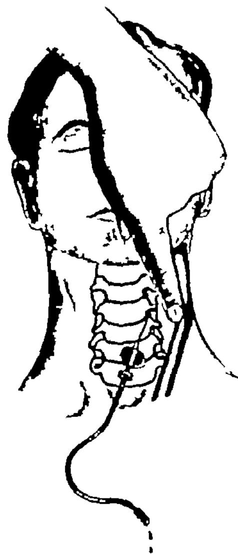


VERTEBRAL ANGIOGRAPHY

Arterial puncture

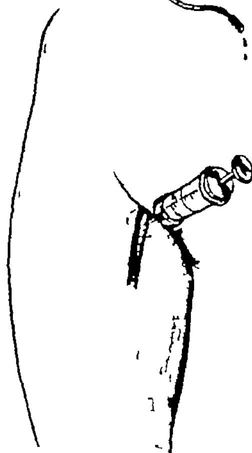
7 The vessel cannot be palpated. The object is to strike it from the anterior approach as it passes from one vertebral foramen to the next, usually between the fourth and fifth cervical vertebrae.

The skin should be punctured about 1 5 cm. more medially than for carotid injection and the carotid artery should be displaced laterally by the index finger of the left hand. The needle is inserted almost vertically and directed slightly laterally until it touches the antero-lateral edge of a vertebral body The point is then slid downwards and ultimately will strike bone (the articular pillar behind the pedicle) This pillar lies only just behind the foramen transversarium which transmits the vertebral artery so that only a very slight withdrawal of the needle should leave the point within the artery It is very easy to pass just medial or just lateral to the artery so several attempts at puncture may be necessary before success is achieved. Furthermore it is very difficult to feel the pulsating vessel under the needle point. Sheldon (1956) has recently devised an excellent needle for this procedure. Its special quality consists in an opening about 2 mm. from the tip



FEMORAL ARTERIOGRAPHY

8 The skin around the inguinal ligament is cleaned after placing appropriate sterile towels around the area. The most proximal portion of the femoral artery is palpated in order to avoid, if possible, making the puncture below the bifurcation. The skin and deeper tissues are infiltrated with local anaesthetic as for carotid angiography

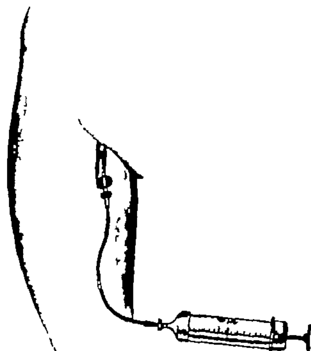


The injection

9 The same type of needle and connecting system is used as for cerebral angiography but in this case it is advisable to make the puncture towards the heart or upwards. This is a further safety precaution lest the vessel is punctured below its bifurcation If the deep femoral artery should be inadvertently punctured the contrast will flow a few centimetres back towards the heart by virtue of the pressure applied during injection. By this means the common and thus also the superficial femoral artery will be opacified.

When the artery has been punctured, using the same detailed technique as for carotid angiography all is ready for the injection of the contrast substance.

The contrast is injected at about the same speed as for carotid angiography and the exposure is begun after about 15 ml. have been injected. There is no necessity to make the exposure time short, indeed it is found that about 0·8–1·0 second is the optimum.



POST-OPERATIVE

After the films have been processed it may be desirable to inject more contrast either to elucidate further some particular point or to take a lateral radiograph. The latter is not usually necessary in femoral arteriography but if desirable the simplest method is to arrange for a horizontal beam with the films lying vertical between the legs of the patient. A portable apparatus can be conveniently used for such work. ■

At the end of the procedure the needle is withdrawn and firm pressure applied for about a minute. There should be no after effects and the operation is so trivial that it can conveniently be performed on out-patients.

[*The illustrations for this Chapter on Arteriography were drawn by Mr J Wheldon.*]

Bibliography

Lindgren, E. (1947) "The Technique of Direct (Percutaneous) Cerebral Angiography" *Brit. J Radiol.*, 20, 326.
Luke, H. A. (1955) "A Flexible Translucent Connection for Arteriography" *Brit. J Radiol.*, 28, 285.
Sheldon, P (1956). "A Special Needle for Percutaneous Vertebral Angiography" *Brit. J Radiol* 29, 340.

AORTOGRAPHY

JAMES BULL, M.D., F.R.C.P., F.F.R.

Radiologist St George's Hospital London Radiologist National Hospital for Nervous Diseases London

PRE-OPERATIVE

Main indications

Aortography is indicated for (1) thrombosis of the lower end of the aorta or of the iliac arteries (2) aneurysm of the abdominal aorta or iliac arteries and (3) renal lesions, when it is desirable to outline the arterial tree

Anaesthesia

A general anaesthetic is preferred because the intense feeling of heat caused by the contrast substance would make it difficult for the patient to remain immobile during the taking of the radiographs. Endotracheal anaesthesia is desirable particularly as the patient lies prone for the examination

Position of the patient

An ordinary x-ray table is used. A flat box with open sides is placed on the table This box should be of sufficient depth to accommodate three casettes laid upon one another The lid of the box should be radiolucent and incorporate a good quality fixed grid size 17 inches by 14 inches. The casettes should be of the same size. Such a box will be about 3 inches deep It is desirable to lay mattresses of a similar depth both above and below the box in order that the patient lies on a flat surface.

The patient lies prone on this surface so that the tenth dorsal vertebra (about 2 inches below the tips of the scapulae) is at the upper end of the box. In a normal sized patient the radiographic field will extend down to about the level of the hip joints.

When the patient has been positioned a control radiograph is taken to confirm (*a*) that the position is correct and (*b*) that the exposure is satisfactory for the particular build of the patient.

The injection

In order to obtain good quality pictures three factors are necessary (1) a rapid injection to avoid too much dilution with blood, (2) a sufficient volume of contrast substance and (3) a sufficiently concentrated contrast medium.

In practice it is found that 80 millilitres is a suitable volume, 70 per cent is the required strength of the medium and the injection should be made as fast as the power of the operator's hands permits Alternatively a manual compressor may be used such as that described by Stirling (1956)

Radiographic procedure

The command to begin the exposure of the first picture should be made after about 20 millilitres have been injected. An exposure time of about 0·6 to 0·8 second is suitable The factors of kilovoltage and milliamperage can be left to a competent radiographer

As soon as the first picture has been exposed an assistant withdraws the top casette from the box without disturbing the other two casettes. The second and third exposures are made as rapidly afterwards as the team is capable of working

The films are processed immediately and saline solution is slowly injected, leaving the needle *in situ*

The films are examined as soon as possible (about 6 minutes) If they are not satisfactory or if it is thought that further information might be obtainable by another injection the procedure is repeated.

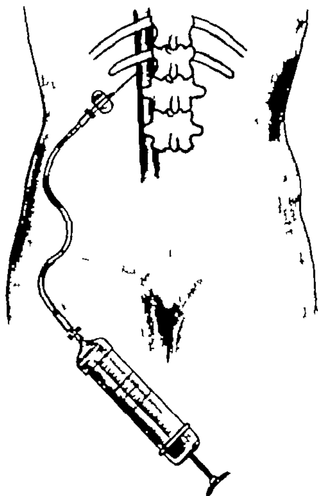
THE OPERATION

1 The skin over the lower dorsal and upper lumbar region is cleaned.

Surface marking—the point just below the left twelfth rib 3 to 4 finger breadths from the mid-line, is normally chosen. A needle about 15 cm. long connected to a system similar to that described in the chapter on Arteriography (see page 105) is used.

The needle is introduced medially and slightly upwards. The first objective is the left side of the body of the vertebra When this is struck the needle is introduced a further 2 or 3 cm. It should now be within the lumen of the aorta and blood should flow freely back along the connecting system. If after two or three attempts no blood returns along the connecting system the anatomical relations of the tip of the needle may be determined by taking a lateral radiograph. A film is placed vertically at the side of the patient and a horizontal beam is used, either from a mobile x-ray unit or another suitable tube in the x-ray room. As a rule the beginner finds that the needle point is not sufficiently deep in the patient. The radiograph should show it lying about 2 cm. in front of the body of the vertebra. If there is still doubt about its position in relation to the aorta, it is advisable to take a posterior-anterior radiograph, exposing one of the films laid in place for the aortography

At the end of the procedure the needle is merely withdrawn.



COMPLICATIONS OF THE OPERATION

It must be stressed that two injections are the limit allowable. More than about 60 ml. of 70 per cent contrast substance probably verges on a toxic dose.

Complications are practically unknown. The needle hole in the aorta rapidly seals and it is thought that only a negligible haematoma develops.

There is, however one potential danger that of having the needle bevel only partly in the lumen of the aorta. If this occurs there is a danger during injection that the coats of the aortic wall may become stripped. This potential danger may be obviated by making an initial test injection of about 5 ml. of 70 per cent contrast material. One radiograph is taken during the injection and it will immediately show if the needle point is properly situated.

[*The illustration for this Chapter on Aortography was drawn by Mr J Wheldon*]

Reference

Stirling, W B (1955). *Brit. med J* 2, 123

CONGENITAL ARTERIO-VENOUS FISTULAS

CHARLES ROB, M.C., M.CHIR., F.R.C.S.
Professor of Surgery St Mary's Hospital London

PRE-OPERATIVE

It is now thought that a number of haemangiomas and lesions known as haemangiomatous malformations are in fact congenital arterio-venous fistulas. Other names for these lesions include cirsoid aneurysm pulsating haemangioma, haemangiectatic hypertrophy and generalized angiomatosis.

Congenital arterio-venous fistulas are of two types—the localized and the generalized. In order to save space the surgery of one example of each type will be discussed on the assumption that in general the lines of treatment are applicable to similar lesions in other parts of the body As an example of the localized type we will take the so-called cirsoid aneurysm of the temporal region of the scalp for the generalized type we will take the diffuse involvement of the vessels of the lower limb

Indications for operation

In the localized type the treatment of choice is local excision when possible. In a limb a partial amputation may be necessary Under these latter circumstances operation should be deferred until either haemorrhage threatens or the local disability is of sufficient severity The generalized type of lesion should be managed conservatively when possible, but ulceration, recurrent cellulitis, recurrent haemarthrosis or the effects on the cardiovascular system may make operation desirable.

Type of operation

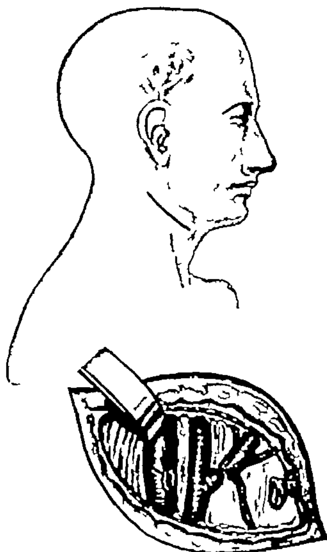
The ideal procedure would be to dissect out and ligate the arterio-venous communications, but this is rarely possible. As stated, the localized fistulas can be excised, but for the generalized type the surgeon must be content with an indirect approach. This may take the form of a synovectomy to prevent recurrent haemarthrosis, epiphyseal stapling to limit the excessive growth of the limb or raising the shoe of the sound leg Here arterial and venous ligation only will be described, which is to date the only vascular operation of value in these patients

Anaesthesia

In most patients general anaesthesia is to be preferred but in some with small localized lesions, excision under local anaesthesia is satisfactory

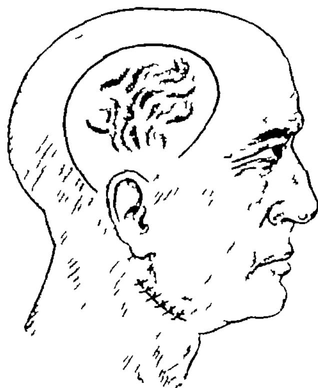
THE OPERATIONS

LOCALIZED TYPE



Ligature of the external carotid artery and facial vein

1 This is an important preliminary measure which reduces considerably blood loss during the operation. A curved incision about 2¼ inches long is made in the line of the skin folds of the neck centred upon the carotid bifurcation. The sternomastoid muscle is retracted backwards, the anterior facial vein tied and the carotid vessels located. The external carotid artery is distinguished from the internal carotid artery by the fact that it has branches. This vessel is ligated in continuity

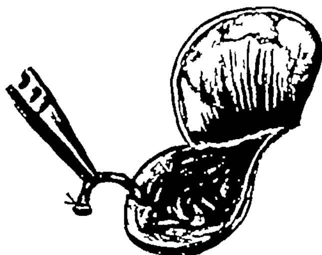


The scalp flap

2 These lesions are most easily approached from the deep surface of the scalp The first step is therefore to turn down a scalp flap containing the fistulas. A curved incision down to the periosteum is made well clear of the lesion and the flap dissected from the skull in the plane just superficial to the periosteum. All large vessels passing to other parts of the scalp are ligated or controlled with sutures and any vessels passing to the bone are coagulated with diathermy If bleeding from these latter vessels persists, firm pressure by an assistant—if necessary for the remainder of the operation—after application of bone wax or haemostatic gauze will produce haemostasis.

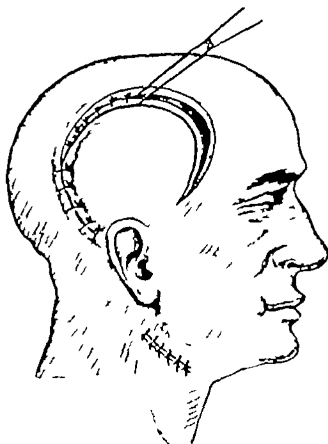
Removal of the lesion

3 The large mass of distended blood vessels contained in the scalp flap is now removed by dissection from the inner or deep surface. Each large vessel is separated from the neighbouring connective and muscular tissues and the whole lesion removed. Any bleeding points are ligated or coagulated with diathermy. Care should be taken to avoid injury to the skin.



Wound closure

4 The galea aponeurotica and then the skin are closed with interrupted sutures. Drainage is rarely necessary. Several small areas of skin necrosis may appear adjacent to the suture line. These should be allowed to separate, when healing will rapidly occur.

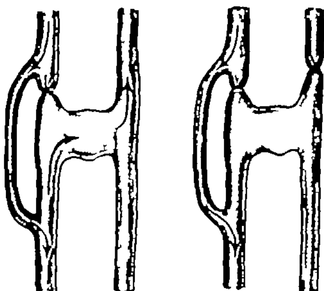


GENERALIZED TYPE

When the skin over the huge pulsating vessels which may form in a limb shows signs of ulceration, then a severe or fatal haemorrhage is likely Arterial and venous ligation reduces the risk of this.

Proximal arterial and venous ligation

5 It is essential to ligate both the artery and the vein. Proximal arterial ligation alone in the presence of an arterio-venous fistula can be disastrous and may lead to loss of the limb The reason, as shown in the accompanying illustrations, is that the viability of the part after arterial ligation depends upon the collateral circulation. After arterial ligation alone most of the collateral flow returns through the fistula to the low-pressure venous system and does not go down the artery to the periphery gangrene usually follows Ligation of the accompanying vein abolishes this tendency and allows the collateral flow to pass down the arterial tree. This observation is of equal importance in both congenital and acquired arterio-venous fistulas.



[The illustrations for this Chapter on Congenital Arterio-venous Fistulas were drawn by Mr R. N Lane]

Bibliography

Holman, E. (1937) *Arteriovenous Aneurysm* New York Macmillan
Reid, M R. (1925) *Arch. Surg.*, 10 997
Robertson D J (1954) *Ann. R. Coll Surg Engl* 18, 73.
— (1957) *Post-grad. med J.*, 33, 7

TREATMENT OF ARTERIAL ANEURYSMS

CHARLES ROB, M.C., M.CHIR., F.R.C.S.
Professor of Surgery, St. Mary's Hospital, London

Operative procedures

Arterial aneurysms have been treated surgically for at least a thousand years. Many of the procedures used in the past have been abandoned, but others, such as proximal ligation, still have a place in their management. The following operations are in use today for the treatment of arterial aneurysms: (1) arterial ligation with or without an arterial by-pass, (2) reinforcing procedures, (3) endo-aneurysmorrhaphy, (4) excision, and (5) excision with reconstruction.

Arterial ligation

Through the centuries an extensive literature has accumulated on this subject and surgeons have placed the ligature in a variety of positions relative to the aneurysm. Today proximal ligation is used in the treatment of intracranial aneurysms and combined with a sympathetic ganglionectomy in the treatment of peripheral aneurysms, but where the aneurysm is on a major artery there is an increasing tendency to employ an operation which restores the arterial flow. This may take the form of an endo-aneurysmorrhaphy, but a better procedure is to use an arterial, venous or plastic arterial substitute. The insertion of this arterial substitute may follow excision of the aneurysm or the surgeon may ligate the artery immediately proximal and distal to the sac and insert the arterial substitute as a by-pass around the sac which is not disturbed. (For arterial ligation, *see* page 81.)

Reinforcing procedures

These have included wrapping in polythene Cellophane sheeting, the injection of substances around the aneurysm and the introduction of various materials into the aneurysm to promote thrombosis. Wrapping in polythene Cellophane has not worked well in practice although other plastics have recently been employed again as a method of reinforcing intracranial aneurysms. Wiring, on the other hand, is still a worthwhile procedure, particularly in elderly and poor risk patients and those with an aneurysm so situated that operative excision carries an unduly high mortality, such as an aneurysm of the arch of the aorta.

Endo-aneurysmorrhaphy

This operation may be performed in one of three ways: restorative, reconstructive and obliterative endo-aneurysmorrhaphy. In the restorative operation the sac is opened after the circulation through it has been controlled and sutures are inserted in such a way that the opening into the vessel is tightly sewn up without occluding the lumen of the artery; the sac is then obliterated by sutures. Reconstructive endo-aneurysmorrhaphy is a similar operation except that a new lumen is formed for the artery from the sac wall, and in the case of obliterative endo-aneurysmorrhaphy both the sac and the artery are completely occluded. The disadvantages of both the restorative and reconstructive operations have been the high recurrence-rate and the fact that they are technically as difficult as inserting an arterial graft or transplant.

Excision

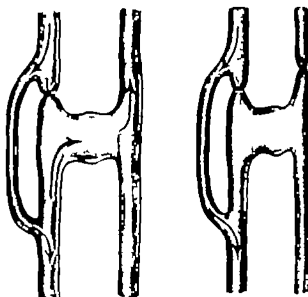
This is the treatment of choice for aneurysms on small and unimportant arteries and for saccular aneurysms of major vessels such as the thoracic aorta or the arteries which make up the circle of Willis. When the anatomical conditions allow, a saccular aneurysm on one of these vessels should be excised and the defect in the host artery closed by lateral suture.

GENERALIZED TYPE

When the skin over the huge pulsating vessels which may form in a limb shows signs of ulceration then a severe or fatal haemorrhage is likely Arterial and venous ligation reduces the risk of this

Proximal arterial and venous ligation

5 It is essential to ligate both the artery and the vein Proximal arterial ligation alone in the presence of an arterio-venous fistula can be disastrous and may lead to loss of the limb The reason as shown in the accompanying illustrations, is that the viability of the part after arterial ligation depends upon the collateral circulation After arterial ligation alone most of the collateral flow returns through the fistula to the low pressure venous system and does not go down the artery to the periphery gangrene usually follows. Ligation of the accompanying vein abolishes this tendency and allows the collateral flow to pass down the arterial tree. This observation is of equal importance in both congenital and acquired arterio-venous fistulas.



[*The illustrations for this Chapter on Congenital Arterio-venous Fistulas were drawn by Mr R. N Lane*]

Bibliography

Holman, E.(1937) *Arteriovenous Aneurysm.* New York Macmillan.
Reid, M. R. (1925) *Arch. Surg* 10 997
Robertson, D J (1954). *Ann. R. Coll. Surg Engl* 18, 73
— (1957) *Post-grad. med J.*, 33, 7

TREATMENT OF ARTERIAL ANEURYSMS

CHARLES ROB M.C., M.CHIR., F.R.C.S.

Professor of Surgery St Mary's Hospital London

Operative procedures

Arterial aneurysms have been treated surgically for at least a thousand years. Many of the procedures used in the past have been abandoned, but others, such as proximal ligation, still have a place in their management. The following operations are in use today for the treatment of arterial aneurysms (1) arterial ligation with or without an arterial by-pass, (2) reinforcing procedures, (3) endo-aneurysmorrhaphy (4) excision and (5) excision with reconstruction.

Arterial ligation

Through the centuries an extensive literature has accumulated on this subject and surgeons have placed the ligature in a variety of positions relative to the aneurysm. Today proximal ligation is used in the treatment of intracranial aneurysms and combined with a sympathetic ganglionectomy in the treatment of peripheral aneurysms, but where the aneurysm is on a major artery there is an increasing tendency to employ an operation which restores the arterial flow This may take the form of an endo-aneurysmorrhaphy but a better procedure is to use an arterial, venous or plastic arterial substitute. The insertion of this arterial substitute may follow excision of the aneurysm or the surgeon may ligate the artery immediately proximal and distal to the sac and insert the arterial substitute as a by-pass around the sac which is not disturbed. (For arterial ligation, *see* page 81)

Reinforcing procedures

These have included wrapping in polythene Cellophane sheeting, the injection of substances around the aneurysm and the introduction of various materials into the aneurysm to promote thrombosis. Wrapping in polythene Cellophane has not worked well in practice although other plastics have recently been employed again as a method of reinforcing intracranial aneurysms Wiring on the other hand is still a worthwhile procedure particularly in elderly and poor risk patients and those with an aneurysm so situated that operative excision carries an unduly high mortality such as an aneurysm of the arch of the aorta.

Endo-aneurysmorrhaphy

This operation may be performed in one of three ways restorative reconstructive and obliterative endo-aneurysmorrhaphy In the restorative operation the sac is opened after the circulation through it has been controlled and sutures are inserted in such a way that the opening into the vessel is tightly sewn up without occluding the lumen of the artery the sac is then obliterated by sutures. Reconstructive endo-aneurysmorrhaphy is a similar operation except that a new lumen is formed for the artery from the sac wall and in the case of obliterative endo-aneurysmorrhaphy both the sac and the artery are completely occluded. The disadvantages of both the restorative and reconstructive operations have been the high recurrence-rate and the fact that they are technically as difficult as inserting an arterial graft or transplant.

Excision

This is the treatment of choice for aneurysms on small and unimportant arteries and for saccular aneurysms of major vessels such as the thoracic aorta or the arteries which make up the circle of Willis. When the anatomical conditions allow a saccular aneurysm on one of these vessels should be excised and the defect in the host artery closed by lateral suture.

sion with reconstruction or arterial by-pass

his was first performed by Lexer in 1907 and in Britain by Pringle (1918) The aneurysm is either excised the artery replaced by a homologous arterial transplant, a plastic implant or an autogenous vein graft, or the ry is ligated above and below the aneurysm and an arterial transplant or vein graft is placed as a by pass around occluded segment.

lications

Iost arterial aneurysms should be treated surgically The reasons for this are that medical measures are without ct, that the aneurysm itself often produces severe symptoms and that a variety of complications may arise. ongst these may be listed rupture, thrombosis peripheral embolization, dissection and pressure on surrounding ctures. Whilst many patients may live for years after an aneurysm has been diagnosed, Colt in 1927 studied aneurysms of the aorta of these 121 were of the abdominal aorta and the average duration of life was less 1 2 years.

ecial pre-operative preparation

ome aneurysms have a treatable cause when possible this should be controlled before the operation. In most ents blood transfusion will be required and arrangements should be made for this in adequate amounts. All ents with aneurysms of major arteries should have a full pre-operative assessment of their cardiovascular em including an electrocardiogram.

ecial contra-indications

chaemic heart disease is usually a contra-indication to major surgery of this type. Another contra-indication nultiplicity of the aneurysms, and arterial reconstruction operations are only possible when there is an adequate ien to the arterial tree distal to the aneurysm.

aesthesia

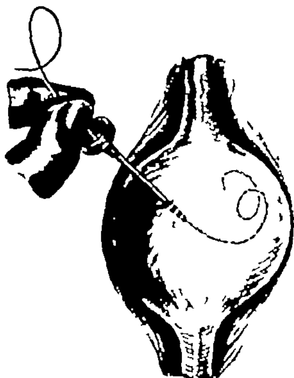
Jeneral anaesthesia with an endotracheal tube is usually satisfactory However when an abdominal aneurysm leaked recently or ruptured the anaesthetic presents a special problem because there is a grave risk of a further ere haemorrhage when the muscles of the abdominal wall are relaxed by the anaesthetic. Some surgeons have ocated the control of the lower thoracic aorta as a first step in these patients, but we have not found this satis- ory and prefer to take the following steps. Anaesthesia is induced without relaxants, the surgeon then makes abdominal incision down to the peritoneum, relaxants are given and the surgeon immediately opens the itoneum and rapidly gains control of the aorta proximal to the sac of the aneurysm.

Vhen the aneurysm is on an artery supplying the brain, the spinal cord or essential organs such as the kidneys, it vise to take special precautions to protect these structures from the effects of ischaemia during the period of iporary arterial occlusion. Hypothermia at 29 C. protects the kidneys for at least 2 hours of complete arterial est but only provides about 15 minutes of protection from complete arrest of the circulation to the central vous system In such patients the maintenance of the blood flow by a temporary shunt graft or occasionally a rt-lung machine is to be preferred. Hypothermia, however gives satisfactory protection for at least 30 iutes when only one internal carotid artery is occluded, and for such patients is preferred to a temporary int.

THE OPERATIONS

WIRING

Introduction of the wire



1 When the aneurysm has reached the superficial tissues introduction may be performed directly through the skin Otherwise it is wise to expose the aneurysm over a portion of its surface but no attempt should be made to isolate or dissect the aneurysm from neighbouring structures. No 30 stainless steel wire is used and this is introduced through a fairly wide bore (gauge 18) needle. If necessary a number of needle punctures can be made The procedure takes a long time and a good length of wire—200 to 1 000 feet—should be introduced, depending on the size of the aneurysm Linton of Boston has designed a simple apparatus for the introduction of the wire.



Function of the wire

2 When fine wire such as No 30 stainless steel is introduced into an aneurysm it bends and curls up as soon as it encounters the opposite wall of the sac or any other obstruction. This means that the whole aneurysm is gradually filled with a bundle of wire around this the blood clots leaving ideally a channel for the blood flow in the centre



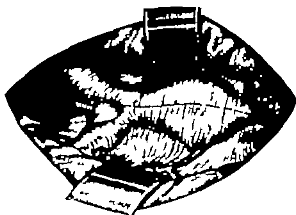
EXCISION WITH RECONSTRUCTION

As a general example to illustrate the principles involved the excision and reconstruction of an aneurysm of the abdominal aorta below the renal arteries will be described. Then the treatment of aneurysms in sites which present special problems will be discussed

Aneurysm of the Lower Abdominal Aorta

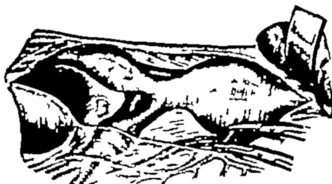
Exposure of the aneurysm

3 Exposure is best achieved with a full length left paramedian incision. The peritoneum on the posterior abdominal wall is then dissected away from the front of the lower abdominal aorta and the common iliac arteries. The incision in the posterior peritoneum should be just to the right of the midline, avoiding the inferior mesenteric artery and vein. Distally it should follow the line of the right common iliac artery Proximally the duodenum should be lifted away from the aneurysm.



Ligation of the inferior mesenteric artery

4 The next step is to ligate and divide the inferior mesenteric artery as close to the aorta as possible The mesentery of the descending colon and the inferior mesenteric vein are then retracted to the left and the duodenum to the right. On the left side the testicular artery and vein run close to the side of the aneurysm they should be retracted with the inferior mesenteric vein or if this is unsatisfactory ligated and divided. On the right side these vessels are rarely seen during this operation, but if they do pass across the operation site they should be divided as well



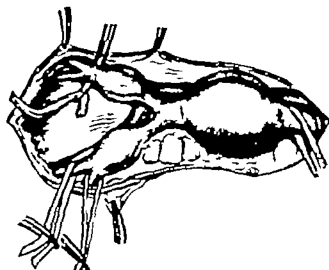
Isolation of the aorta above the aneurysm

5 Fortunately more than 90 per cent of abdominal aneurysms are situated at a sufficient distance below the renal arteries for the surgeon to perform a satisfactory anastomosis with the aorta clamped below these vessels. The aorta between the aneurysm and the left renal vein is freed by careful dissection and a tape is passed round it. Usually one pair of lumbar vessels will be encountered at this stage. They should be preserved until later in the operation and the tape passed above them. The aortic dissection at this level is usually performed without undue difficulty because the inferior vena cava at this point lies at least 1 cm. distant from the aorta.



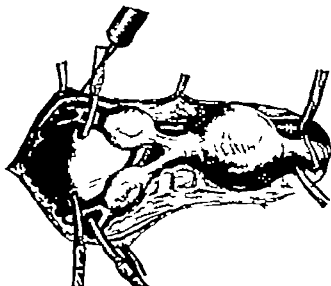
Isolating the iliac arteries

6 In some patients it is sufficient to isolate the two common iliac arteries. When these are aneurysmal the external and internal iliac arteries must be dissected free. In either case very great care must be taken to avoid damage to the accompanying veins, particularly on the right side. Arterial aneurysms are often firmly adherent to the accompanying veins and in most cases separation of the venous from the arterial system is the most difficult part of the operation. If the veins are damaged they should be repaired by careful suturing with 00000 silk.



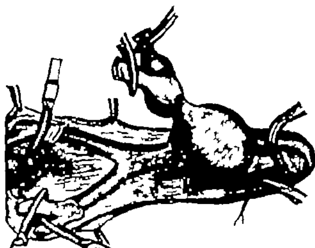
Clamping the aorta and iliac arteries

7 The iliac arteries are now clamped below and the aorta above. I use tape tourniquets over rubber tubes or bulldog clamps for the iliac arteries and a Potts clamp for the aorta. A small bulldog clamp is placed across the pair of lumbar arteries previously isolated just below the site of the aortic clamp or they are divided between ligatures. 8,500 units of heparin are now injected into each iliac artery distal to the clamp and the iliac arteries divided to leave an adequate cuff for the subsequent anastomosis.



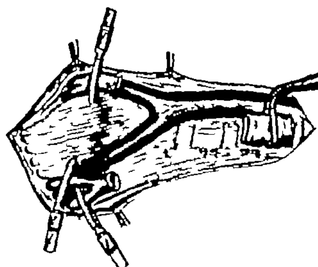
Further dissection

8 Starting distally the proximal ends of the two iliac arteries are lifted up so that these vessels, together with the aortic bifurcation, can be dissected free from the inferior vena cava and iliac veins. This must be done with the greatest care if damage to these veins is to be avoided. It is usually wise to perform this part of the dissection in such a way that the outer or adventitial layers of the aneurysmal sac remain attached to these veins. The next step is to ligate and divide the middle sacral artery and the distal pair of lumbar arteries.



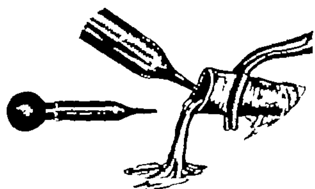
Removal of the aneurysm

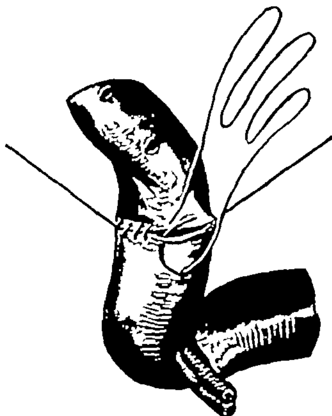
9 The remaining lumbar arteries are now divided and the aorta transected as close to the aneurysm as possible. The aneurysm is then removed. The lumbar veins rarely cause trouble but sometimes a large vein is closely attached to the back of the sac as it passes behind the aorta, in which case the aneurysm is either dissected off this vessel or the lumbar vein is ligated on each side of the aneurysm and removed with it.



Preparation of the arterial ends

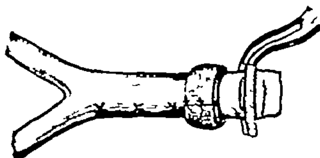
10 The aortic end is prepared by removing any loose tags or plaques, trimming the end with scissors and syringing the open stump with saline to remove any blood clot or loose fragments of intima. It is unwise to strip the adventitia when an aneurysm of the aorta has been resected because this layer will help to hold the sutures in the diseased arterial wall. The iliac arteries are prepared in a similar way and it is usually wise to release the clamps from these vessels at this stage for a few moments to confirm that there is a good back flow and to wash out any clots which may have formed.





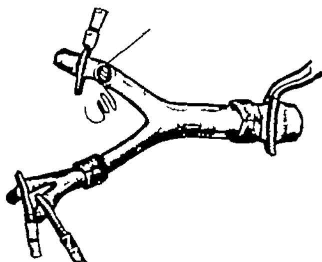
The upper anastomosis

11 When a homologous arterial transplant is being used this anastomosis is best performed with 0000 silk and a fine atraumatic needle but when a plastic implant is being inserted it is sometimes better to use a strong fine eyed needle because the atraumatic needles tend to buckle and break when passing through the plastic material. An over-and-over suture is preferred and, when necessary a two-layered anastomosis can be performed. The posterior part of the anastomosis should be inserted with the transplant or prosthesis held up so that the surgeon can easily reach to the back of the aorta.



Reinforcing the anastomosis

12 When the surgeon is satisfied that he has a first-class anastomosis reinforcement is not necessary but in all cases of doubt it is wise to reinforce the suture line at least temporarily with, for example, a strip of polyvinyl alcohol sponge This is wrapped round the anastomosis and it can be either left in position or removed just before the posterior peritoneum is closed.

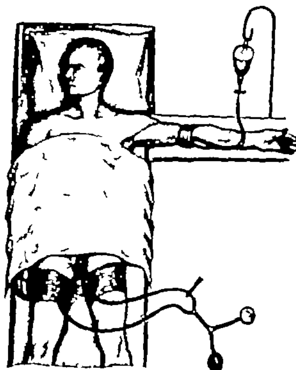


The iliac anastomoses

13 It is usually wise to perform the right first. Great care must be taken to ensure that the transplant or prosthesis is not twisted. Each anastomosis is then performed with a continuous over-and-over suture of 0000 or 00000 silk, the posterior layer being inserted first either from within the artery or by rotating the vessel from side to side. After the anterior layer of sutures has been placed in position the anastomosis can be reinforced with a strip of polyvinyl alcohol sponge as already described.

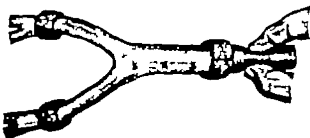
Removal of the clamps control of hypotension

14 This is the critical stage. In patients with generalized arterial disease the fall of blood pressure which occurs at this point may produce coronary ischaemia and death. Every possible step should be taken to reduce this fall of blood pressure as much as possible. First cuffs on the thighs are inflated to above the systolic blood pressure. Next the drip blood transfusion is speeded to a continuous flow Protamine sulphate 10 ml. of a 1 per cent solution should be injected intravenously to counteract the heparin which has already been given. Immediately after this the distal clamps are removed and the transplant or implant allowed to fill with blood. One minute later the aortic clamp is removed.



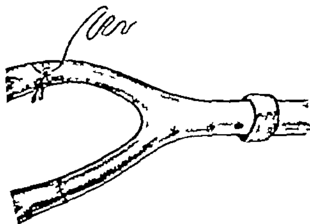
Removal of the aortic clamp

15 The area is now covered with a swab and the aortic clamp slowly removed. The surgeon then holds the aorta proximal to the anastomosis between his fingers and thumb and allows only one heart beat in ten to pass blood into the transplant or prosthesis. At the same time his assistant applies steady but light pressure to the region of the iliac anastomoses As soon as the blood pressure is steady the surgeon allows more and more pulse beats through until he removes his hand altogether



Extra sutures

16 Steady pressure on the suture lines for five minutes by the clock is usually sufficient to control any leaks in exceptional circumstances an extra suture will have to be inserted. Once the whole field is dry and the blood pressure stable at a level of more than 100 mm. systolic the cuffs are deflated on first one thigh and then, after an interval for the blood pressure to recover on the other



Closure of the wound

17 The peritoneum of the posterior abdominal wall is sutured in front of the transplant or prosthesis and the duodenum allowed to fall across its upper end. Care must be taken not to prick the inferior mesenteric vein when inserting the posterior peritoneal suture The anterior abdominal wall is now closed in the usual way An adequate number of deep tension sutures should be inserted because ileus and distension is usual after operations on the abdominal aorta

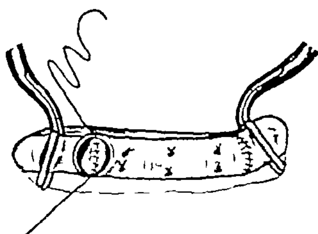


ANEURYSMS IN SPECIAL SITES

For the management of intracranial aneurysms the reader is referred to works on neurosurgery (McKissock, 1956 Botterell and his colleagues 1956)

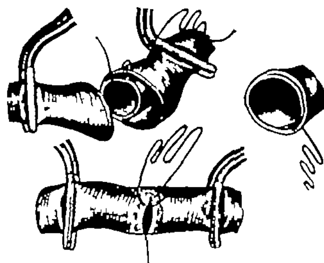
The thoracic aorta and its major branches coarctation aneurysm

18 With the exception of saccular aneurysms with a well-defined neck, aneurysms of the aortic arch are best wired. Aneurysms of the innominate, carotid and subclavian arteries should, when conditions permit, be excised and continuity restored with an arterial transplant. Of special importance is the aneurysm found in association with a coarctation of the aorta. This should be resected with the coarctation and an arterial transplant inserted. For the approach to the aneurysm, see Part V page 150 A similar procedure should be used for aneurysms of the descending thoracic aorta, but here hypothermia or a temporary shunt is required to protect the spinal cord during the period of aortic occlusion.



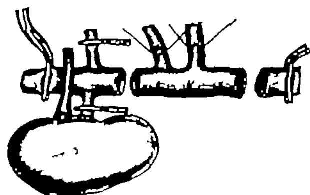
Dissection aneurysms

19 Very occasionally it is possible to treat one of these patients surgically either by resection and the insertion of an arterial transplant or more frequently by the following procedure. The aorta is clamped and transected as near as possible to the site of the dissection. The two channels are then reconverted into one channel by a continuous mattress suture and the continuity of the aorta restored by an end-to-end anastomosis. An alternative procedure which is occasionally effective is to make an opening for the re-entry of the blood from the dissection back into the aorta.



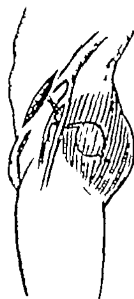
Upper abdominal aneurysms

20 The approach to this region has been described on pages 71–72 Illustrations 22 and 23 Hypothermia or a temporary shunt is essential. The aneurysm is then isolated and removed. The surgeon is then faced with the problem of restoring the flow through the aorta and any of its major branches which have been divided. When one or more branches of the aorta have to be joined to the transplant it is wise to anastomose these branches before the two main aortic anastomoses are made because the extra mobility so obtained simplifies these rather difficult sutures.



Gluteal aneurysms

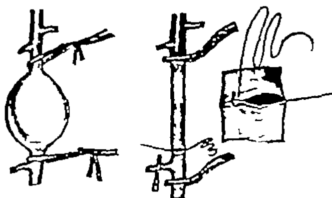
21 These present a special problem because it may be difficult to obtain proximal control from the buttock. For this reason it is wise to place a temporary clamp on the internal iliac via an anterior approach, then to roll the patient on to his side The aneurysm is now removed through a curved incision in the buttock placed well away from the main pressure points the patient is finally rolled on to his back for removal of the internal iliac clamp and closure of the anterior incision.



ANEURYSMS OF THE MAIN ARTERIES OF THE LIMBS—FEMORAL, POPLITEAL, AXILLARY

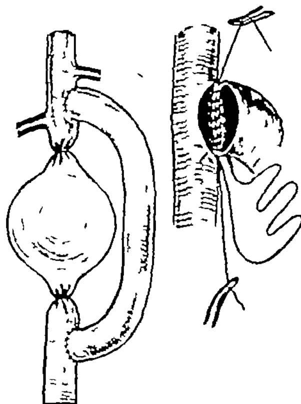
Resection and reconstruction

22 The approach to these vessels has already been described on pages 67 75 and 78 The usual procedure is to resect the aneurysm, dividing the main artery as close to the sac as possible so that the maximum number of collateral vessels are preserved. Continuity is then restored by inserting an autogenous vein graft or homologous artery transplant anastomosed end-to-end to the host artery



By-passing the aneurysm

23 An alternative and perhaps a better method is to by-pass the aneurysm with a homologous arterial transplant or vein graft. The main artery is first ligated immediately above and below the aneurysm. The by-pass arterial transplant is then inserted with an end-to-side anastomosis above and below the points of ligature No attempt is made to interfere with the sac of the aneurysm. The only disadvantage of this method is the possibility that the clot in the aneurysm may become infected.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

The first essential is to maintain an adequate blood pressure to prevent clotting in the transplant or at : site such as the coronary arteries. This is achieved by continuing the blood transfusion if indicated and son the intravenous infusion of noradrenaline at a rate sufficient to maintain the blood pressure at its pre-op level. The blood pressure should be recorded at half-hourly intervals until it is stable.

Anticoagulants

In our view these are dangerous in the immediate post-operative period and should be avoided if possible the first 72 hours. Even with meticulous control serious bleeding can occur On the other hand, long-term a coagulant therapy using Dindevan in sufficient dosage to double the control prothrombin time is wort if the patient has had an arterial transplant inserted with a medium-sized peripheral artery or if the pat occlusive arterial disease This treatment is unnecessary after aortic reconstruction for an aneurysm.

Paralytic ileus

This follows nearly every operation upon the abdominal aorta and every patient should be treated by aspiration by means of a Ryle's tube plus intravenous fluid and electrolyte replacement until intestinal n has been re-established.

Bed-rest and care of the wound

The patient is nursed flat until the blood pressure is stable. After this most patients can be allowed to chair by the third post-operative day In the case of abdominal aneurysms it is wise to leave the deep sutures in for 7–8 days. Patients after temporary clamping of the aorta are liable to develop sacral pressur these are best prevented by careful cushioning with thick foam rubber pads during the operation and nursing afterwards.

Complications of special aneurysms

During the resection of aneurysms arising from the upper abdominal aorta it is necessary to temporarily c the arterial flow to a number of important organs. Hypothermia or a temporary shunt protects against s the effects of this but others require special treatment. Of these, two require special mention. The first is : insufficiency it is wise to give these patients cortisone, 100 mg., on the day of operation and then twice a decreasing doses for the next 3–4 days. The second is citrate intoxication clamping the hepatic artery in with the metabolism of citrate in these patients, therefore only limited quantities of citrated blood should b for transfusion.

Aneurysms on vessels which supply the central nervous system are best operated on under hypothermia include those of the thoracic aorta in patients who have not the benefit of the collateral circulation ar coarctation and those on the carotid arteries (Botterell and his colleagues, 1956) but here a temporary graft may be preferable

[The illustrations for this Chapter on Treatment of Arterial Aneurysms were drawn by Mr R. N Lane]

Bibliography

Botterell, E. H Loughead, W M., Scott, J W., and Vandewater S. L. (1956). *J Neurosurg* **13**, 1
Colt, C. H. (1927). *Quart J Med* **20**, 331
De Bakey M. E Cooley D A., and Creech, O (1956) *Symposium on Cardiovascular Surgery Henry Ford Hospital* 40 delphia Saunders.
Erickson, J E. (1844) *Observations on Aneurysms*. London (for historical references).
Lexer E. (1907). *Arch. Klin Chir* **83**, 459
McKissock, W (1956). *Ann. Roy Coll. Surg Eng* **19** 301
Pringle H. (1913) *Lancet*, **1**, 1795
Rob, C. G. (1954). *Ann Roy Coll Surg Eng* **14**, [illegible]
— Eastcott, H. H. G., and Owen, K. (1956) *Brit. J Surg.*, **43**, 449

ARTERIO-VENOUS FISTULAS

H. H. G. Eastcott M.S., F.R.C.S.

Surgeon St Mary's Hospital London

PRE-OPERATIVE

Indications for operation

Systemic complications of the fistula include progressive cardiac enlargement and eventually congestive heart failure, and sometimes the development of sub-acute bacterial endocarditis. As with patent ductus arteriosus this may be at the site of the fistula, or in the heart.

Local symptoms of a simple fistula may be few but if a sac is present it often produces pressure effects, though rupture is less common than in arterial aneurysms. Venous insufficiency is common, producing thickening and ulceration of the calf and ankle. Buzzing may greatly distress the patient, especially in carotid-jugular fistula. Peripheral ischaemia may develop if the fistula is so large that in effect it draws blood away from the distal part of the limb.

Primary repair has sometimes succeeded in early wounded cases, threatening gangrene and with the advent of the artery bank and synthetic substitutes will probably become one of the standard methods. Early surgery is indicated where there is a serious complicating nerve injury. In some situations, for example, the lung, ablation of the tissues containing the fistula is preferable to direct procedures on the vessels themselves.

Contra-indications

Operation should not be lightly undertaken. The cure of this condition presents considerable technical difficulty and if, as a result, the lesser procedure of proximal arterial ligation is performed, gangrene of the limb often follows, from drainage of the remaining effective circulation back through the fistula. Congenital arterio-venous fistulas, being multiple, scattered and small, are usually unsuited to any form of attempted cure by direct closure.

Operation is not advisable in early cases: when recognized soon after wounding the fistula should not be closed until an adequate collateral circulation has established itself, usually from 3 to 6 months later.

Some small aneurysmal varices need nothing more than an elastic support and regular review for cardiac complications. Very occasionally an arterio-venous fistula undergoes spontaneous closure by thrombosis.

Preparation for operation

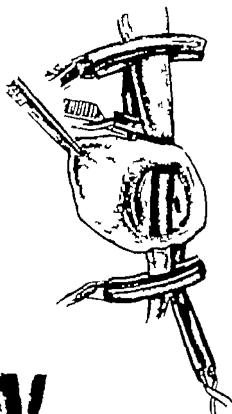
The general condition of the patient must be investigated, paying particular attention to the state of the heart, the haemoglobin level, and if there is fever the result of blood culture. A pre-operative pulse and blood pressure record will be useful for comparison with readings taken after operation.

A blood transfusion should be prepared for but is not routine in these patients for they have an increased blood volume and their heart is already overloaded. However since profuse bleeding may be encountered, it is wise to have an efficient intravenous infusion set up before operation, ready to change to blood if necessary.

Plain radiographs should be taken to localize any suspected metal fragments in the region of the fistula. Arteriograms are not so important as in arterial aneurysm for the length of the affected segment of artery can be assumed to be short: repair should be possible without preparing for a long graft or implant.

Anaesthesia

Spinal anaesthesia is suitable for this operation in the lower limbs: in other situations bleeding during the dissection phase may be reduced by using hypotensive drugs such as hexamethonium, 25 mg. intravenously.



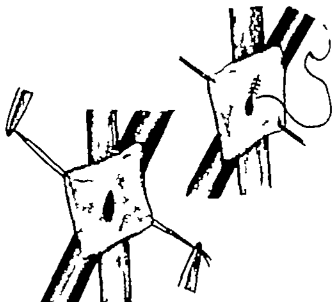
Exploring the fistula itself

6 The pulsation and thrill in the communicating region are now abolished by the clamps, and though the sac may still refill slowly after digital compression it should be opened. The source of any remaining branch is now seen and can be sutured, or the vessel can be located and tied outside the sac, the operator being guided to it by the position of its opening within the sac. The size and position of the fistula are now determined, the foreign body if present is removed, and the type of repair is decided upon.



Quadruple ligation

7 This simple procedure has been the one most generally used. It carries some risk of producing ischaemia, but it is safer than a complicated repair operation when fibrosis and collateral formation are extensive. The ligatures must be placed between the fistula and the first branch of each vessel, whenever possible, to prevent backward loss through the fistula. More than four ligatures are usually needed. The bruit should be completely abolished at this stage, though a small peripheral pulse may be felt.



Transvenous repair of fistula

8 Where the vein is dilated, or forms a sac, the fistula can be explored through it, and repaired with a simple continuous silk suture. The vein is then repaired; it should not be sacrificed to the repair of the artery unless its condition precludes a separate repair lest venous insufficiency follow. Transvenous repair is best suited to cases with a wide zone of adherence between the artery and the vein around the fistula.

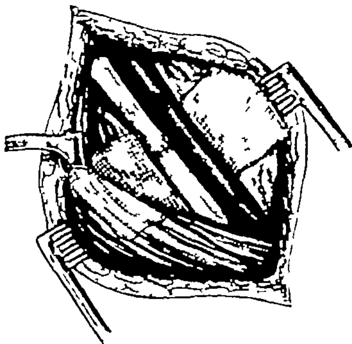
Simple repair of artery and vein

9 There is sometimes sufficient varicose aneurysm formation or increase in the diameters of the artery and vein themselves, to allow tissue to spare for a longitudinal suture of each without much narrowing of the lumen.



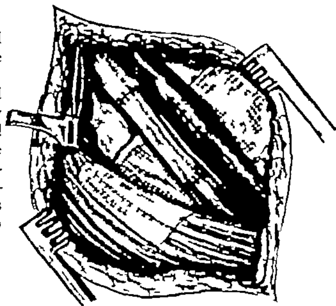
Repair of artery by excision and anastomosis

10 The artery may be much involved in the formation of the sac. Local repair in these circumstances is likely to be followed by recurrence as a simple aneurysm It is better to excise the damaged segment, which is seldom more than an inch or so in length, and then to restore the artery by an end-to-end anastomosis. This is the ideal treatment. Tension can be avoided and the gap closed by the use of posture, for example, by raising the shoulder or flexing the knee. The disparity in size between the two ends is easily overcome by appropriate traction upon the two supporting stitches (see page 82) The vein is sutured first if clotting is thought to be likely or if it would be obscured by the repaired artery



Repair of artery by excision and homografting

11 A longer gap in the artery than can be closed by direct anastomosis is an indication for the insertion of an arterial homograft (see page 95) Though only a short length is usually needed it is better not to sacrifice one of the nearby veins for this purpose for hyperaemia and venous insufficiency are likely sequelae of the reconstruction of the artery A separate dissection of a vein from another part is permissible however and the upper saphenous trunk is very suitable. *It must be reversed, to close its valves.*



POST-OPERATIVE CARE AND COMPLICATIONS

The patient should be nursed as after any arterial reconstruction (see pages 87 92 and 100) with special attention to the local and general circulatory condition Penicillin is advisable (600 000 units of the procaine salt, twice daily by injection for 7 days)

Complications

Cardiac failure may follow the repair of a large fistula. Excessive transfusion after operation is a possible secondary cause, for the blood volume is already increased by the disease. A physician s opinion should be obtained without delay if venous congestion or orthopnoea develop for post-operative chest complications of the usual type are rare after these operations.

Haemorrhage is to be expected if heparin is given after operation (see page 187 for the management of such patients) with good technique it should not otherwise occur Cases of exceptional difficulty should be drained or the wound left open in anticipation of this complication.

Ischaemia of the operated extremity is commoner after the ligation operations, for the reasons previously stated. Pain in the operation region if it exceeds that in the extremity indicates that retained haemorrhage is the cause. The wound should be re-opened, the clot turned out, and the bleeding point dealt with. It will often be impossible to close the skin again delayed suture will be perfectly satisfactory however If the circulation is still inadequate an emergency revision operation is indicated, and some form of reconstruction operation substituted after thrombus has been removed from the main artery above and below the ligatures.

Reconstructive operation should be followed by a phase of hyperaemia in the operated extremity The foot pulses and temperature are regularly observed any sudden deterioration must be considered as a probable indication for re-exploration

[*The illustrations for this Chapter on Arterio-venous Fistulas were drawn by Mr J Wheldon*]

Bibliography

Brown, J J Mason (1949) *Brit J Surg*., War Surg Supp. No 2, 854.
Holman, E. (1937) *Arterio-Venous Aneurysm* New York.
Ross, J Paterson (1946) *Brit med J*., 1, 1

THROMBO-ENDARTERECTOMY

H. H G Eastcott M.S., F R C S

Surgeon St Mary's Hospital London

PRE-OPERATIVE

Selection of patients

This operation has a strictly limited application to a small group of cases within which good results can be readily obtained. Perhaps 8 per cent of an already carefully selected group of patients for operation for arterial obstruction would be found suitable Good pre-operative arteriograms are essential. Preparations must be made in every case for the major procedure of arterial grafting if the lesion should be found to be unsuitable for thrombo-endarterectomy

Indications

Thrombo-endarterectomy is indicated for a limited atheromatous plaque or a recently organized thrombus, which can be removed without disturbance to the artery beyond, and without risk of embolus or dissection when the clamps are removed.

Ideally the operation is suitable for a short, severe obstruction to a common iliac artery also for a removable thrombus of the aorta below the renal orifices, to permit grafting

See also the chapter on arterial and venous grafting (page 93)

Contra-indications

Any patient whose disability does not actually stop him from working is excluded, as are the great majority of diffuse, atheromatous obstructions of the femoral or popliteal arteries all bilateral obstructions, and those occurring in otherwise suitable patients with symptoms of coronary insufficiency and narrow arteries as in most women and small men. These limitations exclude most patients from consideration for thrombo-endarterectomy

Special pre-operative preparations

As already mentioned, it is essential to obtain good arteriographic pictures of the extent of the lesion whose removal is proposed, and also of the remaining vessels in the affected extremity If there is any clinical evidence of arterial occlusion in the opposite limb a further study of this side must be obtained.

Preparations must be made for adequate blood transfusions during and after operation for haemorrhage is a common complication in these patients, whose long arterial suture line in an imperfect arterial wall remnant is not always easy to secure particularly if a course of heparin is to be given after operation.

A suitable arterial homograft or a pliable prosthesis should be available in case the endarterectomy should damage the artery beyond safe repair

Causes of failure

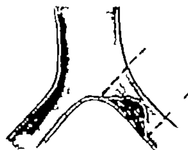
Unless strictly selected many patients will be made worse Haemorrhage and thrombosis are the main reasons an extensive lesion requiring much suturing after the obstruction is removed, in too small an artery may suffer either or both. On the other hand a thrombo-endarterectomy of the abdominal aorta may leave the vessel patent and without leaks, but with too little remaining elastic tissue, so that an aneurysm may develop

THE OPERATION

Lesions suitable for thrombo-endarterectomy

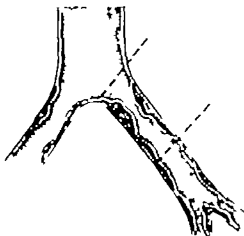
Circumscribed arteriolith

1 This lesion is the circumscribed but prominent plaque, or arteriolith, with relatively normal artery on either side (common iliac, external iliac beneath Poupart's ligament, and the femoral at the adductor opening). This is an uncommon lesion and is ideally adapted to a limited operation (*see* Illustration 5)



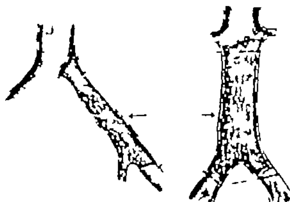
Diffusely sclerotic artery with almost complete obstruction at one point

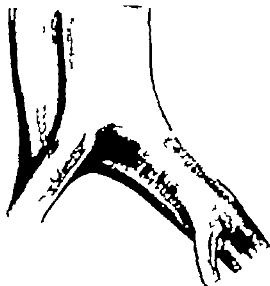
2 Only this portion of the atheromatous tissue should be removed, otherwise when the blood flow is re-admitted the dissection of the plane of cleavage in the media may be carried beyond the point at which it is possible to secure it. More collaterals will thus be obstructed and the patient will be worse off than before the operation.



Provision of stump for anastomosis

3 *In conjunction with an arterial graft* thrombo-endarterectomy may provide a stump sufficiently long for the upper anastomosis, particularly where another important vessel (such as a renal artery or the opposite common iliac) marks the upper limit of the block. In this situation the upper controlling clamp should be partly or fully released so that the pressure of blood above the block may help the process of separating and extracting the obstructing material.

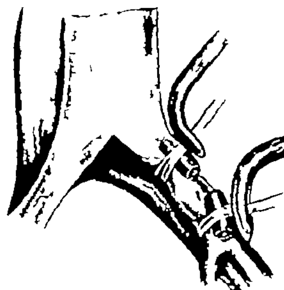




Examination of block

4 The block is examined its extent carefully estimated, and the collateral arteries at its upper and lower ends defined by dissection, for they will need to be controlled before the artery can be opened.

The blocked artery is often densely adherent to the surrounding structures, particularly to the vena cava and the left common iliac vein



A short plaque

5 If the plaque is short, a plane of cleavage can usually be found between the artery and vein above and below it. Controlling tapes are applied sufficiently far apart to allow free manipulation and repair of the artery between them this need not however be mobilized.



Long occlusion of artery

6 A long occlusion of the artery will occasion a wider zone of haemostasis. As a rule this is not difficult to achieve for the artery is less adherent away from the occlusion. A light aortic clamp (Craaford or Brock) is more convenient than a tape for the aortic stem, unless the exposure is wide at the upper end of the wound.

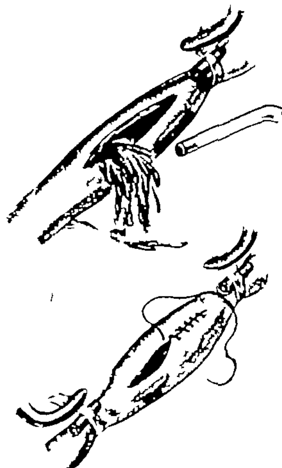


Incision of the artery

7 The shortest possible opening is made in the blocked artery compatible with removing the obstructing material

Removal of the obstruction

8 This varies in its consistency and adherence but a free cleavage plane is found within the adherent medial coat, and except where this is calcified, no special difficulty will be experienced. A Watson-Cheyne dissector is a suitable instrument. Light curettage irrigation and suction are then performed.



Test of patency

9 The lower tape is released a free retrograde flow is essential to the success of this operation. Further dissection must be performed if it is not at first obtained. The lower tape is then replaced and the presence of a pulsatile flow from above is confirmed.

Repair of the artery

10 Both tapes are secured and the isolated segment is irrigated with heparin (500 units in 50 ml.) all loose fragments and fresh thrombus being removed. A continuous suture (0000 arterial silk) is used to repair the artery

POST-OPERATIVE CARE AND COMPLICATIONS

General and local treatment

These are as described for arterial suture grafting and the repair of arteriovenous fistula. Special attention must be paid to the peripheral pulses on the operated side They should return during the operation or shortly afterwards and should increase subsequently

Systemic heparinization

Systemic heparinization is an important but exacting part of the post-operative care of borderline cases of arterial reconstruction It should never be used in aortic cases, and seldom for the iliac. The margin between safe anti-coagulant activity and troublesome post-operative bleeding is extremely narrow The usual doses (10–15 000 units 4–6 hourly intravenously for non-operated patients) are too large.

Patients exhibit marked variations in their response to heparin between one dose to another during the early post-operative period. A clotting time, by the capillary tube method, performed by the bedside is the best guide to the size of the next dose of heparin. The time should be no more than twice normal for the patient The pulse rate, blood pressure and amount of blood loss into the dressings are also taken into consideration when deciding the dosage.

Long-term anticoagulant therapy

This is now under trial the most suitable drug at present being phenylindanedione (Dindevan) This drug gives a more uniform and stable response than earlier drugs of the coumarin group Prothrombin activity is estimated each morning and the result determines that evening's dose Out patients can be *maintained on this drug*, with weekly or even less frequent prothrombin tests, at a level below 30 per cent activity provided they carry capsules of the antidote (vitamin K_1 10–20 milligrams by mouth) to take if haematuria or other evidence of bleeding should develop

[The illustrations for this Chapter on Thrombo-endarterectomy were drawn by Mr J Wheldon]

Bibliography

Dos Santos, C. (1947). *Mem Acad Chir.*, **73**, 400
Reboul, H., and Laubry P (1950). *Proc. R. Soc Med.*, **43**, 547

EXCISION OF SUBCUTANEOUS TISSUES FOR LYMPHOEDEMA

R. Mowlem, F.R.C.S

Surgeon in Charge Plastic Department Middlesex Hospital Surgeon in Charge Centre for Plastic Surger;
Mount Vernon Hospital Northwood

PRE-OPERATIVE

Definition

The types of oedema most frequently subjected to and most amenable to surgery are idiopathic lymphoe the legs and post-operative oedema of the arm. Whilst the clinical behaviour of these two conditions is so the same there is evidence to suggest that their causal mechanics are dissimilar

The arm lesion is an obstructive one due to damage to the lymphatic trunks, either at the time of opera clearance of the axillary glands or later by irradiation. The condition may be complicated by the prese venous obstruction and if so the oedema will appear within a few hours of operation whilst the lymphatic t not be evident for perhaps many weeks.

Lymphangiograms demonstrate a normal vascular pattern, though there is a tendency for tortuosity an tion of the trunks to be obvious. The condition is an obstruction of an otherwise normal system. The first c of oedema in these patients often occurs in the arm itself and the involvement spreads slowly peripherall hand. The disability consists of mechanical limitation of movement, of a sensation of weight on the should and of cosmetic disturbance. Occasionally there is a sensation of bursting, but this can be relieved alm mediately by elevation of the arm.

Lymphoedema of the legs on the other hand is a condition characterized by a swelling commencing ro ankle and often ascribed to a minor injury It slowly spreads centrally The onset is usually about puberty l sometimes be deferred till the second or even the third decades. It may be unilateral or bilateral. It is not pan it causes trouble by its appearance its weight and to a lesser extent by its bulk limiting the potential move the knee and ankle. It does not progress to ulceration except rarely as the result of infection and, with that ex it does not appear to affect the expectation of life Lymphangiograms usually suggest that the lymphatics ar few in number and lacking normal branching

Treatment

Post-operative oedema of the arm may in its earliest phases, be improved by the insertion of a bridge phatic tissue designed to drain the affected arm into the opposite axilla. This is a complicated procedure whi nothing to cure any fibrosis which already exists The bulk of the arm may in addition, be reduced by wedge excision of subcutaneous tissues

When, however fibrosis is well established the procedures outlined below may be indicated.

In the true lymphoedema of the lower limb which is apparently a congenital abnormality of the ly system, there is, as yet, no possibility of the reconstruction of a functional mechanism. The ill-effects c function are reflected almost exclusively in the subcutaneous tissues and it is customary therefore to treat this excision. The exact method whereby this will be carried out varies with the stage of the disability but the aim operation is to remove the whole of the subcutaneous tissue.

Special pre-operative preparation

It is desirable to deflate the leg as much as possible by rest in bed with elevation for some days prior to op

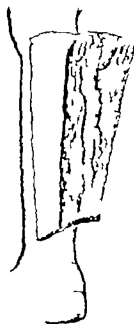
THE OPERATION



Raising of first skin flap

1 A tourniquet is applied after further compression by an Esmarch bandage and a skin flap is raised If there is already very much thickening and fibrosis of the skin this flap will consist of only the superficial part of the skin, the deeper portions being left attached to the subcutaneous tissue This is a difficult and tedious dissection.

When the line of the crest of the tibia is reached, the dissection descends to periosteal level.



Posterior flap

2 A similar flap is raised posteriorly its limit being the centre line of the calf. The subcutaneous tissues are dissected away from the deep fascia and discarded. It is unnecessary to preserve the internal saphenous vein, but if it is removed it should be carefully ligated as *should* any perforating vessels It is often possible and always desirable to spare cutaneous nerves of any size



Replacement of flaps

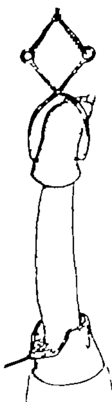
3 Finally the thin skin flaps are trimmed and sutured together Pressure is applied and maintained for 7–10 days, since the flaps of skin are in effect only skin graft thickness and should therefore be treated as grafts.

The other half of the limb can be similarly treated after a delay of some weeks.



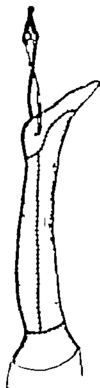
Alternative procedure

4 A more extensive procedure is as follows. The leg is elevated so that the hip is flexed to about 90 degrees



Removal of skin

5 A tourniquet is applied and the skin from the whole of the leg is dissected down to the deep fascia and removed. The margins of subcutaneous tissue left behind are tapered as shown to allow the skin edge to fall freely on to the deep fascia.



Reapplication of skin

6 The removed tissue is spread on a board and three thin split-skin grafts are cut from it. These are sutured together to form a skin stocking which is reapplied under a pressure dressing

If in either procedure the dissection reveals an excessively scarred and fibrotic deep fascia, it may be felt that the chance of survival of skin as a graft on such a base is small. If so the skin may be stored in a refrigerator at a temperature of 0·5–4·0 C and the wound covered with a pressure dressing Within 14 days or even less a satisfactory layer of granulation tissue will have appeared over the surface of the fibrotic fascia and this will form a satisfactory bed for the application of the stored skin as a graft

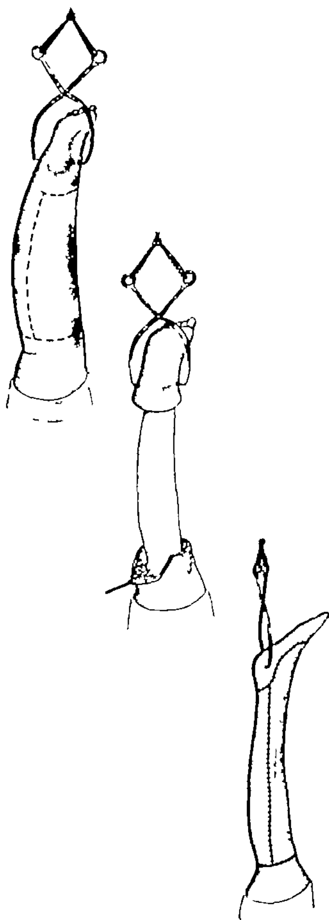
POST-OPERATIVE CARE

Whatever technique is employed will not alter the fact that when healing is complete we will have a recently grafted area below the knee in a patient who is even more prone than normal to develop an oedema when he is erect. Oedema in any recent graft will mean ulceration infection and loss of the skin and perhaps of the limb The patient must therefore be warned of this risk and instructed how to apply and maintain firm pressure bandages for the whole of his waking hours over a period of months. The operative programme is based upon an implied admission that the restitution of normality is impossible and it is designed to replace a progressive lesion with a relatively less unstable repair No small part of the success of the operation must therefore depend upon the patient's co-operative supervision of his own condition

[*The illustrations for this Chapter on Excision of Subcutaneous Tissues for Lymphoedema were drawn by Mr F Price*]

Bibliography

Crockett, D J (1956). *Lancet* **2**, 1179
Gibson, T., and Tough, J. S (1954). *Brit. J Plastic Surg.*, 7 195
Homans, J Drinker C. K., and Field, M E. (1934). *Ann Surg.*, **100** 812.
Kinmonth, J B (1954). *Ann R. Coll. Surg Engl* **15**, 300.
Mowlem, R. (1949). *Brit J Plastic Surg.*, **1**, 48
Parker J M Russo, P E., and Darrow F E. (1955). *Amer Surg* **21**, 845



Alternative procedure

4 A more extensive procedure is as follows The leg is elevated so that the hip is flexed to about 90 degrees.

Removal of skin

5 A tourniquet is applied and the skin from the whole of the leg is dissected down to the deep fascia and removed. The margins of subcutaneous tissue left behind are tapered as shown to allow the skin edge to fall freely on to the deep fascia.

Reapplication of skin

6 The removed tissue is spread on a board and three thin split-skin grafts are cut from it. These are sutured together to form a skin stocking which is reapplied under a pressure dressing

If in either procedure the dissection reveals an excessively scarred and fibrotic deep fascia, it may be felt that the chance of survival of skin as a graft on such a base is small. If so the skin may be stored in a refrigerator at a temperature of 0·5–4·0° C and the wound covered with a pressure dressing Within 14 days or even less a satisfactory layer of granulation tissue will have appeared over the surface of the fibrotic fascia and this will form a satisfactory bed for the application of the stored skin as a graft.

POST-OPERATIVE CARE

Whatever technique is employed will not alter the fact that when healing is complete we will have a recently grafted area below the knee in a patient who is even more prone than normal to develop an oedema when he is erect. Oedema in any recent graft will mean ulceration, infection and loss of the skin and perhaps of the limb The patient must therefore be warned of this risk and instructed how to apply and maintain firm pressure bandages for the whole of his waking hours over a period of months. The operative programme is based upon an implied admission that the restitution of normality is impossible and it is designed to replace a progressive lesion with a relatively less unstable repair No small part of the success of the operation must therefore depend upon the patient s co-operative supervision of his own condition

[The illustrations for this Chapter on Excision of Subcutaneous Tissues for Lymphoedema were drawn by Mr F Price]

Bibliography

Crockett, D J (1956). *Lancet*, **2**, 1179
Gibson, T., and Tough, J S. (1954). *Brit J Plastic Surg.*, **7** 195
Homans, J Drinker C. K., and Field, M. E. (1934) *Ann. Surg.*, **100** 812.
Kinmonth, J B (1954). *Ann. R. Coll Surg Engl.*, **15**, 300
Mowlem, R. (1948) *Brit J Plastic Surg.*, **1**, 48
Parker J M Russo, P E., and Darrow F E. (1955). *Amer Surg.*, **21**, 845

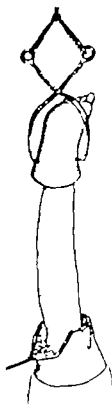
Alternative procedure

4 A more extensive procedure is as follows The leg is elevated so that the hip is flexed to about 90 degrees.



Removal of skin

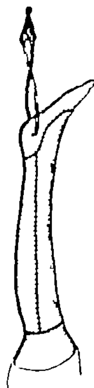
5 A tourniquet is applied and the skin from the whole of the leg is dissected down to the deep fascia and removed. The margins of subcutaneous tissue left behind are tapered as shown to allow the skin edge to fall freely on to the deep fascia.



Reapplication of skin

6 The removed tissue is spread on a board and three thin split-skin grafts are cut from it. These are sutured together to form a skin stocking which is reapplied under a pressure dressing

If in either procedure the dissection reveals an excessively scarred and fibrotic deep fascia, it may be felt that the chance of survival of skin as a graft on such a base is small. If so the skin may be stored in a refrigerator at a temperature of 0 5–4·0 C and the wound covered with a pressure dressing Within 14 days or even less a satisfactory layer of granulation tissue will have appeared over the surface of the fibrotic fascia and this will form a satisfactory bed for the application of the stored skin as a graft.



POST-OPERATIVE CARE

Whatever technique is employed will not alter the fact that when healing is complete we will have a recently grafted area below the knee in a patient who is even more prone than normal to develop an oedema when he is erect. Oedema in any recent graft will mean ulceration, infection and loss of the skin and perhaps of the limb The patient must therefore be warned of this risk and instructed how to apply and maintain firm pressure bandages for the whole of his waking hours over a period of months The operative programme is based upon an implied admission that the restitution of normality is impossible and it is designed to replace a progressive lesion with a relatively less unstable repair No small part of the success of the operation must therefore depend upon the patient's co-operative supervision of his own condition

[*The illustrations for this Chapter on Excision of Subcutaneous Tissues for Lymphoedema were drawn by Mr F Price*]

Bibliography

Crockett, D J (1956). *Lancet* **2**, 1179

Gibson, T., and Tough, J S. (1954) *Brit. J Plastic Surg.*, **7** 105

Homans, J., Drinker C. K., and Field, M. E. (1934). *Ann. Surg.*, **100** 812.

Kinmonth, J B (1954). *Ann R. Coll Surg Engl.*, **15** 300

Mowlem, R. (1949). *Brit J Plastic Surg* **1**, 49

Parker J M., Russo P E., and Darrow F E. (1955) *Amer Surg.*, **21**, 84

ACHILLES TENOTOMY

R. P Jepson F.R.C.S

Professor of Surgery University of Sheffield Consultant Surgeon The Royal Infirmary Sheffield

PRE-OPERATIVE

Indications results of operation

Intermittent claudication is the characteristic symptom of relative muscle ischaemia developed by exercise most commonly associated with an atherosclerotic thrombosis of a major limb artery Many patients ca comfortably with the handicap of the claudication and others will derive benefit from direct vascular surg sympathectomy In a selected group in which other treatment is contra-indicated the limitations imposed by intermittent claudication may be most harassing and it is in these patients that achilles tenotomy may be empl

This operation is designed to decrease the power of contraction and work performed by the gastro-soleus of muscles. The blood supply to the weakened muscle during exercise is therefore more able to satisfy the bolic demands and the claudication distance is thereby increased.

Before this procedure is carried out it must be ascertained that the exercise pain is in fact restricted to the g soleus group If claudication pain is felt in the tibial or foot muscles then this will be enhanced by achilles ten and the patient will derive little benefit. The results are most satisfactory in patients with severe claudicatio than 60 yards) and in limbs with good skin nutrition Boyd and his colleagues (1949) claimed good results in the 24 patients they subjected to this procedure while Schwartz and his colleagues reported good results in 8 10 patients.

This procedure does nothing to improve the blood supply to the ischaemic limb and does not therefore fa ably influence its long-term prognosis.

Contra-indications

Rest pain or gross nutritional changes, such as ulceration are definite contra-indications to the procedure temporary paralysis of the gastro-soleus following tenotomy without doubt causes venous stasis in the n bellies and thus may precipitate thrombo-phlebitis particularly in patients with a history of phlebitis or sw ankles. This can be partly guarded against by supporting the lower leg with crepe bandages in the first two operative weeks.

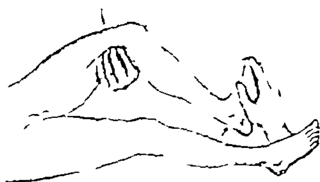
Although the operation has on many occasions been performed bilaterally the results are much superior unilateral claudication. If bilateral tenotomy is contemplated it is preferable to carry out the procedure in two with sufficient interval for the patient to readjust himself to the new flat-footed gait.

If the above criteria are rigorously adopted achilles tenotomy will be found to be indicated in only a percentage of the patients suffering from intermittent claudication.

THE OPERATION

Position of patient

1 The patient lies on his back. The leg is held by an assistant, with the hip moderately flexed abducted and externally rotated, knee flexed to 60 degrees and the foot fully dorsi-flexed. The tendo achillis is thus kept as a tight band by the assistant throughout the manoeuvre



Insertion of tenotomy knife

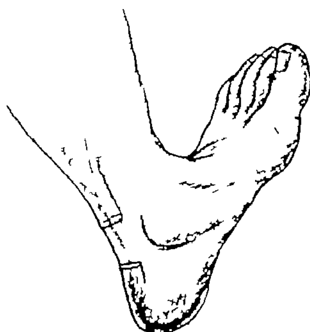
2 The tenotomy knife is pushed along the deep surface of the tendon from within out, with its *cutting edge facing the tendon. The fibres* of the tendon are cut through about 1½–2 inches above their insertion, care being taken not to incise skin other than at the puncture hole.



3

Division of tendon

At the final division of the tendon the foot is felt to suddenly dorsi flex an additional 15–20 degrees. No sutures are required and crepe bandage pressure controls any bleeding. The patient is encouraged to walk the following day.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

The paralysis of the gastrocnemius and gastro-soleus muscles may result in a post-operative deep phlebitis. This may be controlled by supportive bandaging throughout the first few post-operative weeks.

When the patient begins to walk he tends to come down hard on the heel which may become bruised and tender. This common complication may be minimized by fitting a sponge rubber pad inside the heel of the shoe. If both sides are tenotomized at the same session the patient will need the help of sticks for some time to maintain his balance.

[*The illustrations for this Chapter on Achilles Tenotomy were drawn by Miss Dorothy Davison*]

References

Boyd, A. M., Ratcliffe, A. H., Jepson, R. P., and James, G. W. H. (1949). *J Bone Jt Surg.*, 31 B, 325.
Schwartz, D. L, Pennock, L. L., Passolino, C. J. and Littman, D. S. (1952). *J Bone Jt Surg* 34-A, 619

PART VIII

ENDOCRINE GLANDS

PART VIII ENDOCRINE GLANDS

Section I: Thyroid Gland — Page

Subtotal thyroidectomy 5
Radical thyroidectomy 18
Hemithyroidectomy: resection, enucleation, and cervical approach to retrosternal goitre 18
Excision of lingual thyroid and thyroglossal cyst or sinus 22

Section II: Parathyroid Gland

Exploration of the parathyroid glands 27

Section III: Thymus Gland

Thymectomy 32
TRANS-STERNAL APPROACH
TRANS-PLEURAL APPROACH

Section IV: Pituitary Gland — Page

Exposure of the pituitary region by the frontal approach 39
HYPOPHYSECTOMY

Interstitial irradiation of pituitary 47

Section V: Adrenal Gland

Exposure and resection of adrenal gland for tumour: transdiaphragmatic approach 51

Sub-total adrenalectomy: abdominal approach 57

Total adrenalectomy using lumbar incisions 63

SUBTOTAL THYROIDECTOMY

CHARLES ROB, M.C., M.CHIR., F.R.C.S.
Professor of Surgery, St Mary's Hospital, London

PRE-OPERATIVE

Indications

The operation is indicated for primary thyrotoxicosis after a physician has advised surgical treatment, second thyrotoxicosis, and some cases with adenoparenchymatous (non-toxic nodular) goitre

In thyrotoxicosis the object is to effect a permanent lowering of the basal metabolic rate to normal. adenoparenchymatous goitre may be removed for cosmetic reasons, for the relief of pressure symptoms or prevent certain complications including malignant change thyrotoxicosis or a sudden increase in size haemorrhage into a cyst should occur

Special contra-indications

In *malignant exophthalmos* removal of the gland worsens the condition. Thyroidectomy must be avoided in established cases and in young men who have marked exophthalmos and little disturbance of pulse or b metabolic rate In *elderly patients* with a large long-standing nodular goitre the tracheal rings may have absorbed. Removal of the goitre allows the walls of the trachea to fall together resulting in occlusion of airway

When a unilateral *laryngeal nerve paralysis* has resulted from a previous operation, medical treatment should given every possible chance before surgery is again undertaken. Some surgeons for medico-legal reasons inspection of the vocal cords as a routine before thyroidectomy

Special pre-operative preparation in patients with thyrotoxicosis

Carbimazole (80 mg daily) or propylthiouracil (200 mg per day) should be started about 6 weeks bef operation they can be taken at home if a doctor is in attendance About 2 weeks before operation Lugol's (5-15 min. 3 times daily) should be given after one week thiouracil may be stopped and iodine only given for final few days. This combination of drugs reduces the basal metabolic rate and leaves a relatively avascular gl With only mild thyrotoxicosis, a large goitre or an unfavourable reaction, the preparation is with iodine alc severe thyrotoxicosis may occasion a longer period of preparation The guiding factors are the patient's state and response to the drug. A period of rest in hospital also serves to improve the general condition ar sedative such as phenobarbitone (1½ gr twice daily) is of value.

Anaesthesia

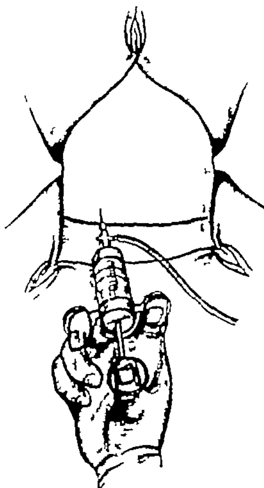
General anaesthesia with an endotracheal tube is generally satisfactory In nervous patients a basal dose of Av may be given half an hour before induction. In some hospitals local infiltration with Novocain is used.

Position of patient

A low pillow is placed between the shoulder-blades, the headpiece of the table is slightly lowered and the wh table tilted so that the patient's head is about 1 foot higher than the feet. The neck is thus extended and head raised sufficiently to prevent venous engorgement.

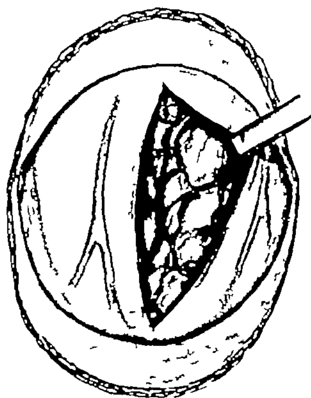
Arrangement of towels.—After preparing the skin, two towels and a sheet of jackonet are placed under the he the top towel is then folded over to cover the head completely from the point of the chin upwards. Other tov are placed on each side of the head and neck and over the trunk and legs. A pad of sterile absorbent wool may tucked behind the base of the neck on each side

THE OPERATION



The incision

1 The incision follows the skin folds of the neck it is about 7 inches long and in the midline passes about 1 inch above the sternum When a general anaesthetic is used it is of help to infiltrate the area of the incision, and that portion of the neck from which the skin flaps are to be raised, with a dilute solution of adrenaline (1 800 000) this greatly diminishes bleeding and facilitates the dissection of the skin flaps. The addition of hyaluronidase to this solution causes its rapid diffusion within the tissues and thereby reduces the time spent over the injection.



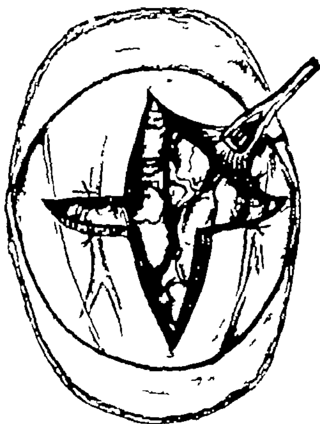
Skin flaps

2 After the platysma has been incised throughout the length of the incision the skin flaps are raised in the plane deep to this muscle, the upper flap as far as the notch on the thyroid cartilage the lower to the sternum. Care should be taken to remain superficial to the anterior jugular veins injury to these vessels is best avoided by cutting upwards and outwards towards the platysma muscle Skin towels may now be applied and the skin edges held apart by Joll's self retaining retractor The deep fascia is then incised along the anterior edge of each sternomastoid muscle and the infrahyoid muscles are separated by a vertical incision through the cervical fascia in the midline of the neck

Additional exposure and preliminary mobilization of gland

3 When additional exposure is necessary the infrahyoid muscles may be sectioned transversely The line of section of these muscles should be about 1 inch above the level of the skin incision this reduces the risk of the two scars adhering to each other It is wise to tie and divide the anterior jugular veins before sectioning the muscle

The capsule of the gland is now visible At this stage it is imperative to get into the right layer many of the difficulties of thyroidectomy are due to the dissection being carried out in the wrong layer The thyroid gland has a false capsule derived from the cervical fascia and a true capsule which covers the gland itself. The dissection must be performed in the space between these two This means that after retraction of the infrahyoid muscles another layer the false capsule, requires incision before the dissection is commenced. The whole gland is now examined in order to confirm the diagnosis and decide how much should be removed

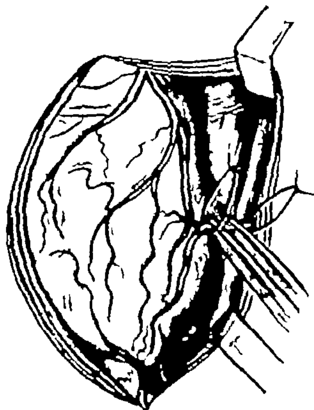


Exposure and division of the middle and inferior thyroid veins

Division of these vessels allows the surgeon to lift up the lobe of the gland and to retract it medially It is important to resist the temptation to mobilize the gland by finger dissection. This will often tear the middle thyroid vein. A dry field is essential if damage to the recurrent laryngeal nerve is to be avoided.

The middle thyroid vein

4 This vein passes from the lateral margin of the gland to the internal jugular vein. As with all veins draining the thyroid gland, it is thin-walled and easily torn. Many surgeons tie these veins with a ligature on an aneurysm needle this avoids the risk that artery forceps may tear off the thin veins. Once the middle thyroid vein has been divided the mobilization of the lobe becomes easier

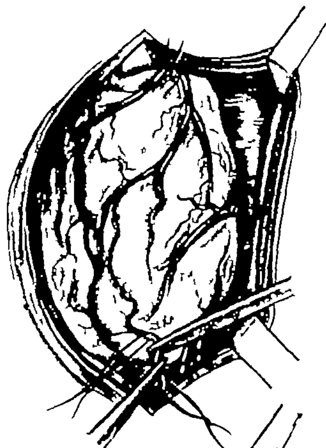


The inferior thyroid veins

5 The inferior thyroid veins are usually 3 or 4 in number on each side and they run down to join the innominate vein.

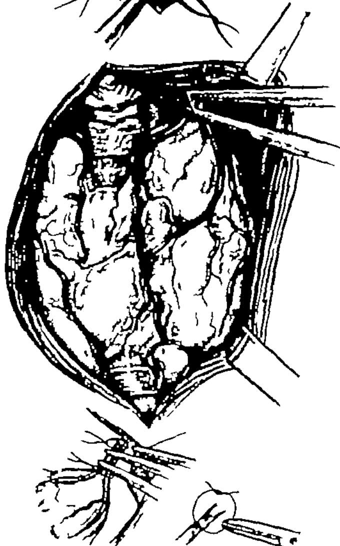
These veins should always be individually ligated and divided as mass ligation of several veins carries the risk that one of them will retract out of the ligature.

At the same time, a thyroid ima artery if present should be ligated and divided. This vessel arises from the innominate artery or the arch of the aorta and passes in front of the trachea to reach the isthmus of the gland



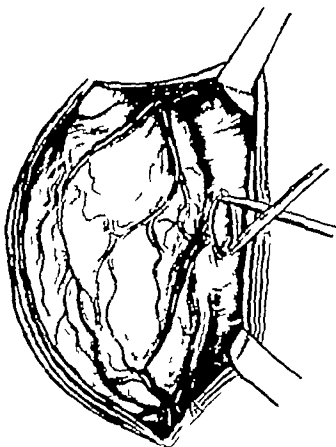
Exposure and division of superior thyroid vessels

6 The superior thyroid vessels are exposed by retracting the gland downwards and the muscles upwards and outwards they are then isolated and divided between ligatures. Some surgeons when ligating these vessels use 3 artery forceps, the upper ligature being placed at the site of the top forceps after it has been removed. In this instance it is usual to depart from the practice of ligating an artery and vein separately The superior laryngeal nerve may be injured during this manoeuvre and in an occasional patient with a small thyroid low in the neck the recurrent laryngeal nerve passes close to the superior thyroid artery A careful dissection in the right tissue plane between the layers of the capsule and close to the vessels avoids these nerves.



Exposure and identification of inferior thyroid artery and recurrent laryngeal nerves

7 A finger is now placed in the wound and the inferior thyroid artery palpated It runs transversely from under the carotid sheath to enter the thyroid gland at the mid-point of its posterior surface. This vessel is higher than one expects. At the same time the recurrent laryngeal nerve is palpated This is often a simple matter for the nerve can be rolled gently against the tracheal rings and once felt it can be seen through the covering fascia. If the nerve cannot be identified by palpation it should be exposed by careful dissection this is a wise precaution because the position of these nerves varies. The left nerve is more constant in position than the right and it runs slightly nearer to the trachea It is a mistake to dissect out the recurrent laryngeal nerve because a temporary paralysis may follow in an anatomically intact nerve It should merely be identified either by palpation or exposure and its course confirmed.

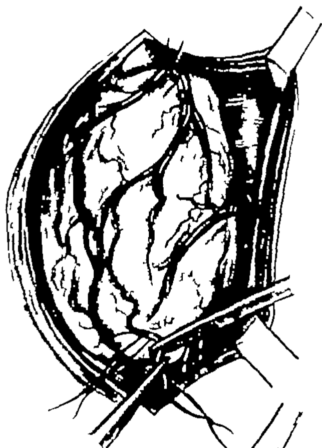


Ligation of inferior thyroid artery

8 In order to ligate the inferior thyroid artery it is necessary to make a small incision in the posterior layer of the false capsule just over the vessel. At this stage one or more of the parathyroid bodies may be seen these should be preserved but a special search is unnecessary The artery is ligated in continuity at a point a quarter of an inch or more lateral to the recurrent laryngeal nerve and close to the carotid sheath which is retracted laterally Some surgeons consider that greater mobilization can be obtained if this artery is divided rather than ligated in continuity

The first lobe of the gland to be mobilized is replaced in its bed and a similar dissection performed on the opposite side. This can be simplified if the surgeon moves his position to that on the patient's other side When a pyramidal lobe is present it must be removed as well



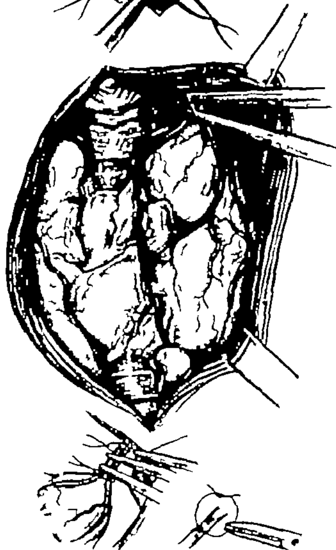


The inferior thyroid veins

The inferior thyroid veins are usually 3 or 4 in number on each side and they run down to join the innominate vein.

These veins should always be individually ligated and divided as mass ligation of several veins carries the risk that one of them will retract out of the ligature

At the same time, a thyroid ima artery if present should be ligated and divided This vessel arises from the innominate artery or the arch of the aorta and passes in front of the trachea to reach the isthmus of the gland.

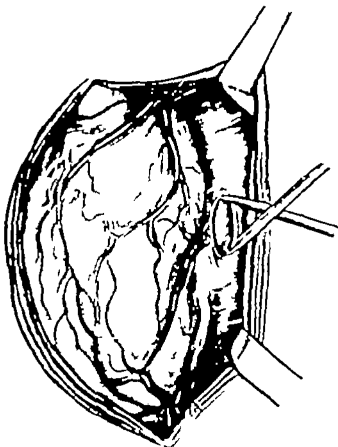


Exposure and division of superior thyroid vessels

The superior thyroid vessels are exposed by retracting the gland downwards and the muscles upwards and outwards they are then isolated and divided between ligatures. Some surgeons when ligating these vessels use 3 artery forceps, the upper ligature being placed at the site of the top forceps after it has been removed. In this instance it is usual to depart from the practice of ligating an artery and vein separately The superior laryngeal nerve may be injured during this manoeuvre and in an occasional patient with a small thyroid low in the neck the recurrent laryngeal nerve passes close to the superior thyroid artery A careful dissection in the right tissue plane between the layers of the capsule and close to the vessels avoids these nerves.

Exposure and identification of inferior thyroid artery and recurrent laryngeal nerves

7 A finger is now placed in the wound and the inferior thyroid artery palpated. It runs transversely from under the carotid sheath to enter the thyroid gland at the mid-point of its posterior surface. This vessel is higher than one expects. At the same time the recurrent laryngeal nerve is palpated. This is often a simple matter for the nerve can be rolled gently against the tracheal rings and once felt it can be seen through the covering fascia. If the nerve cannot be identified by palpation it should be exposed by careful dissection; this is a wise precaution because the position of these nerves varies. The left nerve is more constant in position than the right and it runs slightly nearer to the trachea. It is a mistake to dissect out the recurrent laryngeal nerve because a temporary paralysis may follow in an anatomically intact nerve. It should merely be identified either by palpation or exposure and its course confirmed.



Ligation of inferior thyroid artery

8 In order to ligate the inferior thyroid artery it is necessary to make a small incision in the posterior layer of the false capsule just over the vessel. At this stage one or more of the parathyroid bodies may be seen; these should be preserved but a special search is unnecessary.

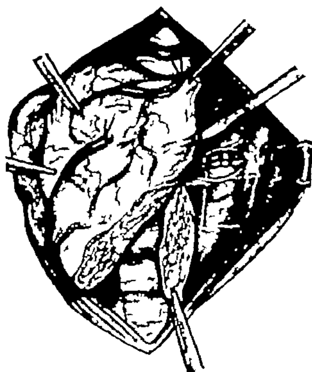
The artery is ligated in continuity at a point a quarter of an inch or more lateral to the recurrent laryngeal nerve and close to the carotid sheath which is retracted laterally. Some surgeons consider that greater mobilization can be obtained if this artery is divided rather than ligated in continuity.

The first lobe of the gland to be mobilized is replaced in its bed and a similar dissection performed on the opposite side. This can be simplified if the surgeon moves his position to that on the patient's other side. When a pyramidal lobe is present it must be removed as well.



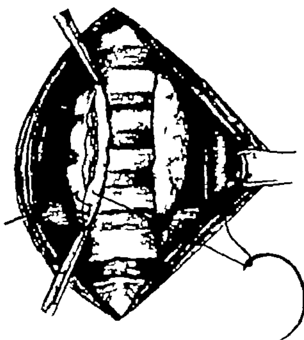
Removal of gland

9 After both lobes have been freed the gland is ready for removal Artery forceps are placed as markers on the gland just behind the line of section and each lobe is cut across leaving a small plaque of gland tissue covering the recurrent laryngeal nerves and parathyroid bodies the whole isthmus is then removed. It is advisable to cut the gland obliquely with the angle sloping towards the trachea this simplifies suture of the raw surface, and if necessary the outer margin may be sutured to the fascia covering the trachea.



Suturing of remnants

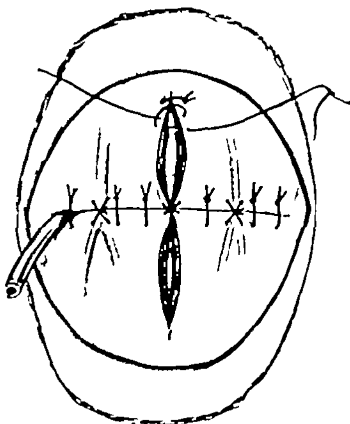
10 At the conclusion of this stage only one-eighth of the gland should remain if the operation is for thyrotoxicosis, but more if it is for an adenoparenchymatous goitre, whether it be toxic or non-toxic. Any bleeding points on the cut surface of the gland should be tied, and the ooze is diminished still further by suturing the borders of the gland remnants to each other if the bleeding persists application of a free graft from the infrahyoid muscles, irrigation with hot saline solution or one of the artificial haemostatic agents should be tried. Sometimes it is impossible to suture the borders of the gland together In these patients the bleeding may be reduced by suturing the lateral edge of the thyroid remnant to the trachea.



Closure

11 The wound is then closed in layers. First the infrahyoid muscles and the deep cervical fascia are sutured, and next the platysma. Finally attention is given to the suturing of the skin. Some surgeons omit the suturing of the platysma as a separate layer.

Partial flexion of the neck may assist closure of the strap muscles if these have been sectioned transversely. Interrupted sutures are preferred for the infrahyoid muscles and a continuous suture of fine catgut for the platysma. It is important to avoid non-absorbable sutures for structures superficial to the infrahyoid muscles because even with a meticulous technique sinuses may form, particularly if the wound has been drained.

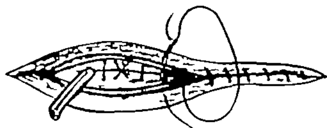


Drainage

12 In the majority of patients it is unnecessary to effect drainage if satisfactory control of bleeding points has been achieved during the operation but it is a wise precaution to drain whenever there is doubt.

Additional points

In some patients one or both lobes of the thyroid gland may have enlarged posteromedially and come to lie behind the trachea and oesophagus. When mobilizing such a gland special care should be taken because the recurrent laryngeal nerve is easily damaged. As an alternative some surgeons divide the isthmus of the thyroid and then remove each lobe separately. This manoeuvre may assist the dissection particularly in those difficult patients who have many adhesions as can occur when thyrotoxicosis has failed to respond to thiouracil.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

A sedative linctus is of value during the first few days and it is wise to continue the Lugol's iodine for a week or more after operation. The wound heals rapidly and the skin stitches may be taken out on the second or third day; the drain should be removed after 24 hours.

Reactionary haemorrhage

Haemorrhage following thyroidectomy differs from haemorrhage elsewhere in that a small quantity of blood deep to the cervical fascia may compress the trachea and produce acute dyspnoea. This is an emergency and prompt removal of all sutures and evacuation of the clot are first essentials; later the patient is taken to the operating theatre to secure the bleeding point and to re-suture the wound.

Thyroid crisis

The use of thiouracil in the pre-operative preparation of thyrotoxic patients has made this complication a rarity. The treatment is to give an intravenous infusion of saline solution containing 100 min. of Lugol's iodine per day, to prescribe large doses of sedative drugs and to keep the patient cool.

Vocal cord palsy

Paralysis of one vocal cord usually results in disturbance of the voice but may be symptomless. Paralysis of both results in respiratory obstruction. With a unilateral lesion treatment is unnecessary beyond observation to see if the *recurrent laryngeal nerve lesion is permanent or temporary. Many patients with a bilateral cord palsy require a* tracheotomy and further surgery if the lesion is permanent (Woodman's operation—Part XVIII, Volume 8).

Tetany

Tetany is due to removal or disturbances of all the parathyroid glandular tissue. The treatment is to give calcium lactate by mouth (30–60 gr. 3 times daily); if this does not relieve the spasms parathormone should be given.

Hypothyroidism

This condition is not uncommon after operations on adenoparenchymatous goitres; the treatment is to administer thyroid extract.

[The illustrations for this Chapter on Subtotal Thyroidectomy were drawn by Mr. J. Wheldon.]

Bibliography

Berlin, D. D., and Lahey, F. H. (1929). "Dissection of the Recurrent and Superior Laryngeal Nerves." *Surg. Gynec. Obstet.* 49, 102.
Bowden, R. E. M. (195). "The Surgery of the Recurrent Laryngeal Nerve." *Proc. R. Soc. Med.*, **48**, 487.
Means, J. H. (1948). *Diseases of the Thyroid Gland*, 2nd ed. Philadelphia and London: Lippincott.
Rundle, S. F. (1951). Joll's *Diseases of the Thyroid Gland*, 2nd ed. London: Heinemann.

RADICAL THYROIDECTOMY

CHARLES ROB, M C M CHIR F R C S
Professor of Surgery St Mary's Hospital London

PRE-OPERATIVE

Indications

Primary malignant disease of the thyroid gland is the only indication for this operation The operation of radical thyroidectomy is sometimes justified in the presence of distant metastases particularly if they take up a significant quantity of radio-active iodine There is evidence that removal of the thyroid gland stimulates metastases of thyroid origin to take up more radio-active iodine

Objects and contra-indications

The objects of and contra-indications to radical thyroidectomy are similar to those for malignant disease of other organs. It is stressed that radical thyroidectomy is an operation designed to eradicate malignant disease It differs therefore from the subtotal operation in a number of ways including the removal of a large portion of the platysma, infrahyoid and sternomastoid muscles, one internal jugular vein and as many of the cervical lymph nodes as possible

Special pre-operative preparation

In some patients a pre-operative course of radiotherapy may make it possible to resect a previously inoperable tumour Before operation the vocal cords should be examined a precaution which is worth taking before every operation on the thyroid gland. About 8 per cent of patients with simple goitres have a unilateral vocal cord palsy and in carcinoma of the thyroid the incidence rises with the extent of the disease

Anaesthesia

Occasionally one of these patients presents with gross respiratory obstruction while tumour makes a tracheotomy impossible until late in the operation Under these circumstances it is wise when possible to pass an endotracheal tube under local anaesthesia and defer the induction of general anaesthesia until a satisfactory airway has been established. When this is impossible the only alternative may be to cut through tumour tissue under local anaesthesia and establish a low tracheotomy relying upon radiotherapy and perhaps further surgery for treatment of the disease once the acute episode has passed

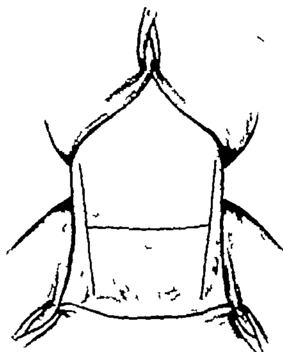
Position of patient

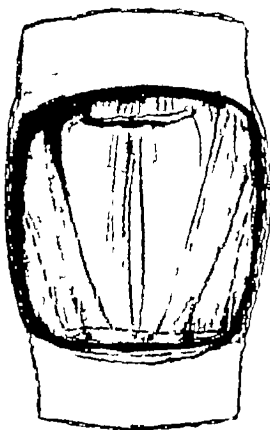
The position of the patient and the arrangement of the towels are the same as for a subtotal thyroidectomy An exception must be made in the case of those patients who have an obstructed airway and require a tracheotomy for under these circumstances the patency of the airway is the overriding consideration the position of the patient's head and neck should be the optimum in each particular case This usually means more flexion of the neck than is convenient for the surgeon at least until a tracheotomy has been performed

THE OPERATION

The incision

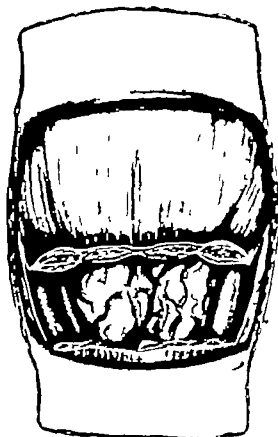
1 This is approximately H-shaped. The transverse limb follows the skin folds of the neck at the level of the cricoid cartilage and the vertical limbs lie over by the sternomastoid muscles, being more widely separated at their superior than inferior ends. As with other thyroid operations, it is a help when general anaesthesia is used to infiltrate the area of the incision with a solution of adrenaline (1 800 000) to which hyaluronidase has been added





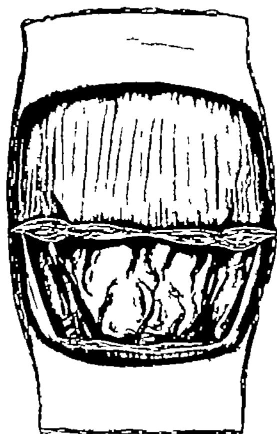
Skin flaps

2 The skin flaps should be raised in the plane superficial to the platysma muscle. This, as compared with the subtotal operation leaves an extra layer between the tumour and the surgeon. Two main flaps are raised, the upper as far as the hyoid bone and the lower to the sternum In addition the skin from the lateral margins of the wound should be freed for a sufficient distance to expose the whole width of each sternomastoid muscle from the level of the hyoid bone to the sternum and clavicles.



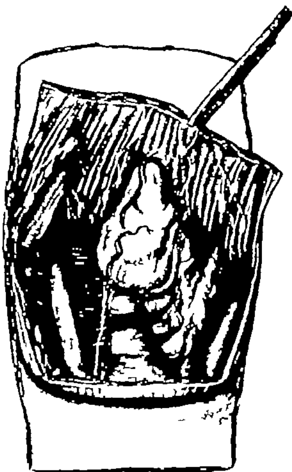
Division of the muscles

3 The platysma muscle is now divided at the root of the neck and along the outer border of the sternomastoid muscles. The infrahyoid muscles and both sternomastoid muscles are now freed from their attachments to the sternum and clavicles and turned upwards



Division of the veins

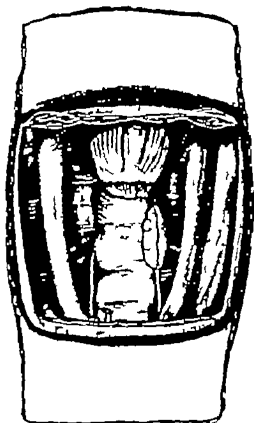
4 Division of the lower attachments of the infrahyoid and sternomastoid muscles will have exposed the internal jugular and inferior thyroid veins. The inferior veins should be divided as far from the gland as possible and the internal jugular vein on the side of the tumour should be divided at the root of the neck. The object is to perform a complete block dissection on one side of the neck and a partial block dissection on the other



Block dissection of the neck

5 The whole mass of tissue consisting of the divided internal jugular vein, one lobe of the thyroid gland, the deep cervical chain of lymph nodes and the associated muscles, is now turned upwards and to the opposite side The inferior thyroid artery is tied and divided behind the carotid sheath and the lobe of the gland with its isthmus separated from the trachea. Sometimes it is necessary to cut away the outer layers of the tracheal wall if possible at least one recurrent laryngeal nerve should be preserved.

A similar dissection is now carried out on the opposite side except for the fact that the internal jugular vein should be preserved, and often it is possible to leave a small portion of the thyroid gland on the side farthest from the tumour



Division of the superior attachments

6 The tumour is now free except for its superior attachments. The platysma, infrahyoid and sternomastoid muscles should now be divided high in the neck leaving the superior thyroid vessels, the internal jugular vein and the lymphatic chain to be sectioned. This is done as high as possible and the whole mass removed. It consists of the whole of one lobe of the thyroid gland with its false capsule and the parathyroid glands from that side the thyroid isthmus and the greater part of the opposite lobe of the thyroid gland, the greater part of the platysma, both sternomastoid and the infrahyoid muscles one internal jugular vein and both of the deep cervical chains of lymphatic glands.

POST-OPERATIVE CARE AND COMPLICATIONS

Special points

The post-operative care and complications are similar to those which occur after the operation of subtotal thyroidectomy

If it has not been possible to preserve either recurrent laryngeal nerve it may be necessary to perform a tracheotomy soon after removal of the endotracheal tube

A tumour which is confined to one lobe of the gland is the most suitable for this operation If during the dissection it is found that the spread of the growth has made it impossible to dissect in definite tissue planes, then the operation should be abandoned and radiotherapy prescribed after a portion has been taken for microscopical examination

In an occasional patient it is justifiable to split the sternum and continue the dissection so that it will include the anterior mediastinal group of lymph nodes.

Involvement of the trachea may make a tracheotomy necessary but occasionally it is possible to resect and reconstruct the trachea. In one personal case a fairly large portion of the trachea was resected and the defect closed by a tube of tantalum gauze and fascia lata this patient is at work 6 years later

[*The illustrations for this Chapter on Radical Thyroidectomy were drawn by Mr J Wheldon*]

Bibliography

Crile G and Crile, G., Jnr (1937). "Radical Operation for Malignant Tumours of the Thyroid Gland." *Surg Gynec Obstet.*, 64, 927

Rob, C. G., and Bateman, C. H. (1949). "The Reconstruction of the Trachea and Cervical Oesophagus." *Brit J Surg.*, 37 202

Rundle, S F (1951) Joll's *Diseases of the Thyroid Gland* 2nd ed. London Heinemann.

HEMITHYROIDECTOMY, RESECTION ENUCLEATION AND CERVICAL APPROACH TO RETROSTERNAL GOITRE

CHARLES ROB, *M C* M CHIR F R C S

Professor of Surgery St Mary s Hospital London

PRE-OPERATIVE

Indications

The modern trend has been to perform the operations of hemithyroidectomy and resection enucleation less and less frequently most surgeons preferring the operation of subtotal thyroidectomy but they still have a place in certain cases.

True adenoma of the thyroid, a relatively uncommon lesion is an indication for either of these two operations, usually resection enucleation

Some patients with a non-toxic nodular goitre have pressure symptoms due to one large nodule. Whilst it is usually wise to perform a subtotal thyroidectomy in such patients, occasionally the opposite lobe contains so few nodules that a hemithyroidectomy is indicated.

Occasionally the patient may present with a thyroid nodule which is possibly carcinomatous but the diagnosis is not firm enough to warrant a radical operation Under these circumstances a hemithyroidectomy is justified.

HEMITHYROIDECTOMY

General principles

The lobe of the thyroid gland is mobilized in the same way as for a subtotal thyroidectomy the inferior and middle thyroid veins and the superior thyroid vessels, are tied and divided. The whole lobe is now displaced medially to expose the inferior thyroid artery and the recurrent laryngeal nerve Many surgeons when they do a hemithyroidectomy leave a portion of the gland behind to protect the recurrent laryngeal nerves in this case the operation is not actually a hemithyroidectomy but a subtotal resection of one lobe. As such an operation is identical with that of resection of one lobe in the operation of subtotal thyroidectomy it will not be discussed further True hemithyroidectomy when the whole of one lobe is removed, will be described in so far as it differs from subtotal thyroidectomy

RESECTION ENUCLEATION OF A THYROID ADENOMA

General principles

The advantages of this operation over hemithyroidectomy or subtotal thyroidectomy are that it is simpler and quicker to do and that the recurrent laryngeal nerve will rarely be at risk of damage However the adenoma must be localized. In some patients the adenoma can be enucleated, but this is often unsatisfactory because a cup-shaped bed is left which may be difficult to obliterate

CERVICAL APPROACH TO A RETROSTERNAL GOITRE

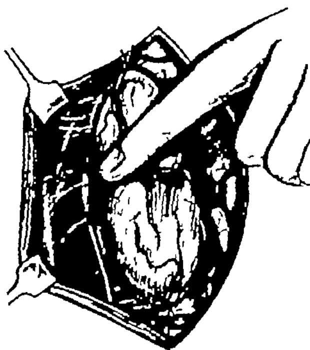
It is important to distinguish between the relatively common substernal or retrosternal thyroid which is merely a projection downwards from a gland placed in the usual situation in the neck and the uncommon true intrathoracic thyroid which arises from ectopic thyroid tissues placed sometimes as low as the diaphragm, the operation for which has been discussed in Part V (Volume 8)

THE OPERATIONS

HEMITHYROIDECTOMY

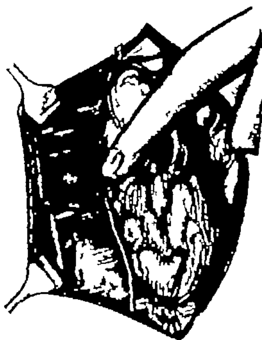
Division of the inferior thyroid artery

1 After the superior thyroid artery and vein, and the middle and inferior thyroid veins have been divided, the inferior thyroid artery can be exposed. The gland should be retracted medially the artery identified by finger palpation (occasionally this vessel is absent or too small to feel) the common carotid artery retracted laterally and the inferior thyroid artery exposed, tied and divided well away from the thyroid gland behind the carotid sheath After this the recurrent laryngeal nerve should be isolated as it passes close to this vessel or between its branches. It is usually necessary to divide the branches of this artery again in order to separate them from the nerve when the proximal end need not be tied again and an artery forceps on the end adjacent to the thyroid helps to retract the gland towards the opposite side of the neck.



Dissection of the recurrent laryngeal nerve

2 When a whole lobe is to be removed it is essential to expose the recurrent laryngeal nerve throughout that part of its course which is in relationship to the thyroid gland. The nerve should be identified below the thyroid gland and then followed upwards until it disappears under the inferior constrictor muscle During this exposure it is important not to mobilize the nerve completely it should be disturbed as little as possible, merely identified and the thyroid gland removed from it. Several fine filaments leave the nerve to supply the trachea and oesophagus complete mobilization not only divides these but frequently results in a temporary vocal cord palsy in a patient with an anatomically intact nerve The operation of hemithyroidectomy is now completed by dividing and suturing the thyroid isthmus, and the wound is closed in the manner described for subtotal thyroidectomy



RESECTION ENUCLEATION OF A THYROID ADENOMA

Exposure

The gland is exposed in the manner already described (*see* Part VIII, page 6) and the whole gland palpated with care to confirm that the adenoma is either solitary or the rest of the gland so nearly normal that a resection enucleation is justified. It is important to avoid this operation if there is a reasonable suspicion of carcinoma. In such a case a radical thyroidectomy or a hemithyroidectomy should be performed.

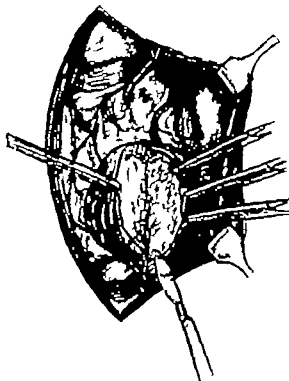
Mobilization

3 The portion of the thyroid gland containing the adenoma is now mobilized. It is necessary in nearly every patient to divide the inferior and middle thyroid veins and the superior thyroid artery and vein but rarely necessary to expose the inferior thyroid artery or the recurrent laryngeal nerve. In some patients when the adenoma is in the isthmus or on the front of one of the lobes adequate mobilization can be obtained by dividing one or two veins and in the case of the isthmus freeing the gland tissue from the trachea.



Resection

4 After adequate mobilization the gland tissue deep to the adenoma is clamped with a number of artery forceps and the adenoma plus a cuff of thyroid tissue removed. The gland tissue included in the artery forceps is then ligated and the edges of the defect approximated with interrupted sutures. As an alternative the gland may be cut across with a knife and the bleeding points picked up individually with artery forceps this latter method, although surgically more ideal, may be difficult in practice if the thyroid arteries have not been tied. The wound is now closed.

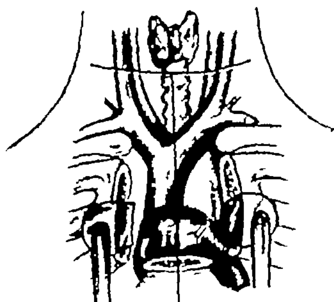


CERVICAL APPROACH TO RETROSTERNAL GOITRE

The incision

5 A collar incision is satisfactory for most retrosternal goitres, but in some large benign retrosternal enlargements and thyroid carcinomas it is necessary to obtain additional exposure. After exposure of the thyroid gland the decision should be made whether to split the sternum or not. It is stressed that this manoeuvre is rarely necessary.

To split the sternum the skin is incised in the midline from the centre of the collar incision to the level of the 3rd costal cartilage. This exposes the whole of the manubrium and its joint with the body of the sternum. A finger or blunt dissector is now introduced into the anterior mediastinum and the posterior surface of the manubrium freed. Using a chisel or sternal bone shears the manubrium is now split in the midline vertically to the level of the second intercostal space and then transversely into this space. The two portions of the sternum are now held apart by a self-retaining thoracotomy retractor.



Removal of the retrosternal portion of the thyroid

6 The first step is to ligate the thyroid arteries and veins. A finger is then passed round the retrosternal portion of the thyroid and this is mobilized and delivered into the neck, after which any untied inferior thyroid veins are secured and a subtotal thyroidectomy performed. Gentle traction on the thyroid gland during this manoeuvre will assist the delivery of the retrosternal portion and may aid identification of the remaining inferior thyroid veins. When the retrosternal portion is benign and so large that it cannot be delivered intact into the neck, it is better to break up the retrosternal portion with the finger and deliver it piece by piece than to split the sternum. But if there is doubt that it may be malignant then the sternum should be split. Sometimes the gland contains several large cysts and the aspiration of these may reduce its size sufficiently to allow delivery into the neck.



[The illustrations for this Chapter on Hemithyroidectomy, Resection, Enucleation and Cervical Approach to Retrosternal Goitre were drawn by Mr J. Wheldon.]

EXCISION OF LINGUAL THYROID AND THYROGLOSSAL CYST OR SINUS

CHARLES ROB, M C, M CHIR F R C S

Professor of Surgery St Mary's Hospital London

PRE-OPERATIVE

Indications

In common with ectopic tissue generally a lingual thyroid or a thyroglossal cyst or sinus should be removed because of the cosmetic effects of a thyroglossal cyst, the dysphagia which may develop in patients with a lingual thyroid and because a thyroglossal cyst may become infected. A thyroglossal sinus usually follows an incomplete operation for a thyroglossal cyst and here the persistent discharge will be an added reason for surgery

Special contra-indications

In approximately 50 per cent of patients with the rare lesion of a lingual thyroid and much fewer of those with the more common thyroglossal cyst this will be the patient's only thyroid tissue. Therefore every patient with these *abnormalities should have a careful examination of the neck by palpation and, if this fails to reveal a definite thy-*roid gland, a tracer dose of radio-active iodine should be given to establish the location of the patient's thyroid glandular tissue. In patients with thyroid tissue in the normal situation operation may be performed, but if there is no thyroid in the neck a different plan should be adopted. Boca and Marioni (1951) have excised a lingual thyroid from such a patient and transplanted it to the anterior abdominal wall 2 years later the patient's basal metabolic rate was + 2 per cent, and 82 per cent of a dose of radio-active iodine was taken up by the abdominal thyroid this procedure is the obvious answer because an autogenous graft in a patient who has been rendered thyroid-deficient should function satisfactorily

Anaesthesia

In patients with a lingual thyroid it is essential to pass an endotracheal tube and to pack off the region of the operation in order to prevent the inhalation of blood.

Position of patient

This is similar to that used for other thyroid operations but with a slightly greater extension of the neck. The insertion of a mouth gag is essential when a lingual thyroid is to be excised through the mouth.

Arrangement of towels

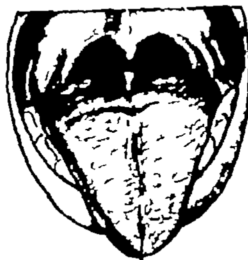
After preparing the skin two towels and a sheet of jackonet are placed under the head the top towel is then folded over to cover the patient's head from the upper lip upwards. This allows the surgeon to work within the mouth should the patient have a lingual thyroid, or tongue depression be needed to assist the dissection of the upper portion of the track of the thyroglossal cyst or sinus.

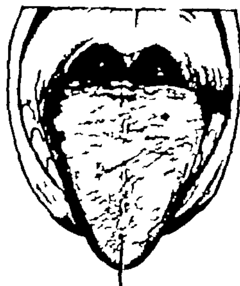
THE OPERATIONS

LINGUAL THYROID

Removal

1 If submucous this can be performed through the mouth a traction stitch should be placed through the tip of the tongue which is then drawn as far out of the mouth as possible
2 The mouth is held open with a gag The mucosa over the thyroid is then incised longitudinally and reflected from the gland. The gland is now enucleated from the tongue the numerous small vessels being controlled by ligatures, sutures or diathermy The defect in the muscles of the tongue may now be closed with interrupted catgut sutures and the mucous membrane repaired in the same way





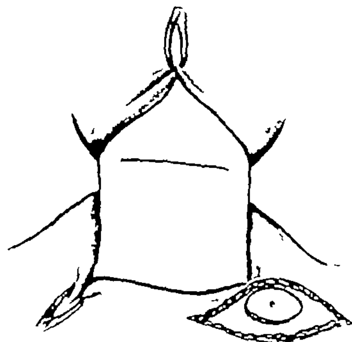
Closure transplantation of gland substance

If tests have shown that this is the patient's only thyroid tissue the gland substance should be washed in saline, cut into slices about 1 mm. thick and placed in the abdominal wall both superficial and deep to the sheath of the rectus abdominis muscle

THYROGLOSSAL CYST OR SINUS

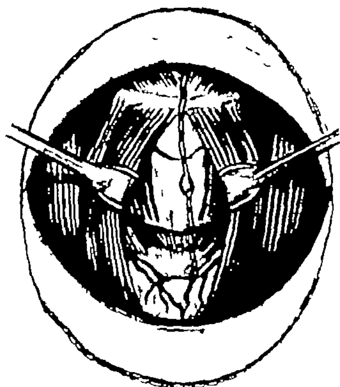
The incision

3 All abnormalities of the thyroglossal duct, with the exception of the submucous lingual thyroid, are best approached from the neck the incision, therefore follows the skin folds of the neck and should be placed so that its mid-point lies over the centre of the hyoid bone. It is usually sufficient to make the incision about 3 inches long The skin flaps are raised in the plane deep to the platysma muscle. When the patient has a sinus this should be left undisturbed at this stage within a ring of skin.



Isolation of the cyst and duct

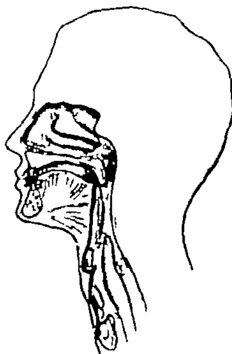
4 It is essential to remove the whole thyroglossal track. Small portions of epithelium if left behind will lead to a recurrence. The infrahyoid portion should be dissected free and detached from the thyroid gland it is usually attached by a fibrous cord to the upper margin of the isthmus or the left lobe the presence of a cyst or thyroglossal thyroid aids identification, but if there is a discharging sinus and much fibrosis, perhaps from previous unsuccessful operations, then it may be necessary to resect or block-off tissue rather than the track alone
Sometimes when there is a discharging sinus it is possible to introduce a fine polythene tube into the opening and up the track at least as far as the hyoid bone If this is done gently a false passage is not produced and the presence of the tube greatly assists the identification of the track.

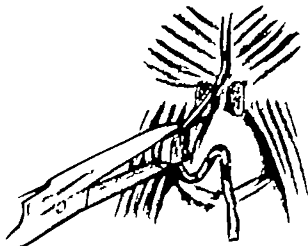


Removal of the central portion of the hyoid bone

Anatomical pattern

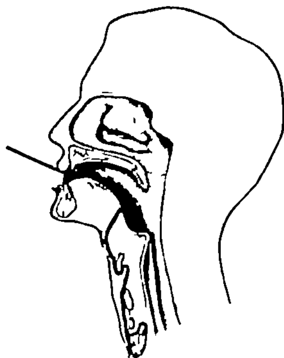
5 The thyroglossal duct passes in front of the hyoid bone, then takes a looped course up behind this bone before continuing down. In order to be certain of removing the whole of the duct it is essential to remove $\frac{1}{2}$–$\frac{3}{4}$ inch of the centre of the hyoid bone Fortunately this produces no demonstrable abnormality





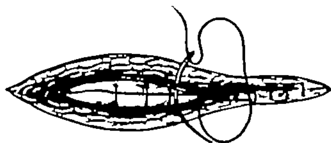
Method of removal

6 The bone should be isolated by both blunt and sharp dissection at two points, each about ¼ inch from the midline. It is then divided with bone forceps at these two points and the central block of tissue containing the bone and the thyroglossal duct removed.



Removal of the intra-glossal portion of the thyroglossal duct

7 At this stage it is of value to place a sterile spatula into the mouth and depress the region of the foramen caecum of the tongue towards the incision. The track is now followed as far as possible and the whole removed. But it is not necessary to go so far that there is any risk of opening the mucous membrane of the mouth.



Closure

8 No attempt should be made to suture the ends of the hyoid bone together. The infrahyoid muscles are now approximated in the midline of the lower portion of the wound and the platysma and closed in the usual way.

SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

The operations of radical thyroidectomy hemithyroidectomy resection enucleation of a thyroid adenoma, excision of a lingual thyroid and removal of the thyroglossal duct have similar post-operative problems to those already listed in the chapter on Subtotal Thyroidectomy but, in addition, some complications are more frequent after one or other of these operations and they will now be mentioned.

Removal of all thyroid tissue

This may occur either as part of a radical total thyroidectomy for carcinoma or less frequently after the removal of a lingual or other abnormally situated gland which is the only source of the patient s thyroid hormones. Adequate replacement with 0 1 g thyroid extract twice daily is essential for the remainder of the patient s life.

Oedema of the glottis or trachea

Occasionally after an extensive resection of a carcinoma which has been adherent to the air passages, oedema and swelling may develop to a sufficient extent to produce respiratory obstruction. Whilst it may be necessary to perform a tracheotomy and it is always wise to aspirate all possible fluid and other secretions from the air passages, the inhalation of a mixture of helium and oxygen may be of great value in relieving cyanosis and respiratory distress. In a proportion of patients this may allow time for the oedema to settle and save the patient from a tracheotomy

[The illustrations for this Chapter on Excision of Lingual Thyroid and Thyroglossal Cyst or Sinus were drawn by Mr J Wheldon]

Bibliography

Boca, E., and Marioni, V (1951). *Chirurgie*, 6, 511
Sistrunk, W E. (1928). *Surg Gynec. Obstet.*, 46, 109

EXPLORATION OF THE PARATHYROID GLANDS

CHARLES ROB, M C M CHIR F R C S

Professor of Surgery St Mary's Hospital London

PRE-OPERATIVE

Indications

Hyperparathyroidism, which may be due to an adenoma, an adenocarcinoma or hyperplasia of all or part of the parathyroid tissue is the usual reason for operating upon these glands in addition a carcinoma which is endocrinologically inactive may occasionally be found It is important to stress that hyperparathyroidism does not only cause symptoms through its effects upon bone in many patients the presenting symptoms are produced by urinary calculi.

Special pre-operative care

Because of the association with skeletal abnormalities and urinary calculi these systems should be carefully investigated before operation.

Anaesthesia

General anaesthesia with an endotracheal tube is necessary because of the thorough exploration of the neck which may be required.

Position of patient

This is the same as that used for the operation of subtotal thyroidectomy

Removal of the parathyroid tissue

A parathyroid tumour once it has been located, should be completely excised. It is of importance that they may be multiple and so the discovery of one parathyroid adenoma does not excuse the surgeon from a complete exploration of the parathyroid-bearing area of the patient's neck. It is a mistake however to explore the mediastinum after removal of a tumour from the neck unless the post-operative course of tests indicates that a second tumour exists. If the surgeon finds enlarged and hyperplastic parathyroid glands then he should preserve a quantity about the size of a garden pea and remove the rest.

Operative arteriography as an aid to tumour location

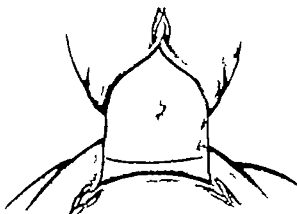
Steiner Fraser and Aird (1956) have used arteriography as an aid to the location of a parathyroid tumour If after routine exploration of the neck the tumour has not been found, inferior thyroid arteriography using 10 ml. of 50 per cent diodone is performed. This will outline the tumour and is of particular value when the tumour is situated some distance from the usual sites.

THE OPERATION

The incision and exposure

An incision similar to that for subtotal thyroidectomy is satisfactory. Occasionally if symptoms have recurred after removal of a parathyroid adenoma from the neck it may be necessary to explore the mediastinum. As a wide exposure of the posterior surface of the thyroid gland is required it is wise to divide the infrahyoid muscles in every case and meticulous haemostasis is essential.

The middle and inferior thyroid veins are next identified and divided on each side of the neck. This allows the surgeon to displace first one and then the other lobe of the thyroid gland medially.

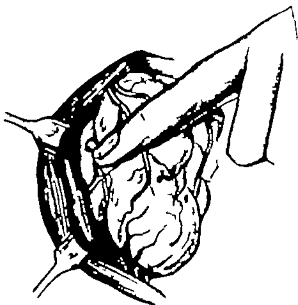


Identification of the parathyroid glands

If a tumour is present it may be easily felt and removed but these tumours may be multiple and it is wise to identify all four parathyroid glands in a patient who suffers from hyperparathyroidism. normal parathyroid tissues should not be removed except in small quantities for biopsy.

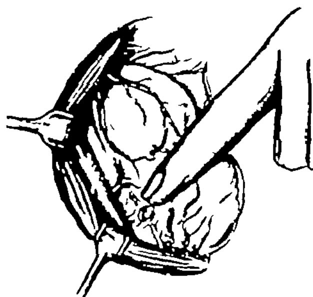
The superior parathyroid glands

2 These are the more constant in position and therefore more easily located than the inferior parathyroid glands. They are situated between the thyroid gland and its capsule at the level of the inferior border of the cricoid cartilage. They are close to the postero-lateral margin of the oesophagus. After displacement of the lobe of the thyroid gland forwards and medially they come into view as yellowish-brown nodules about the size of a garden pea. if they are smaller than normal it is strong evidence that a hyperfunctioning parathyroid tumour is present in another of the parathyroid glands.



The inferior parathyroid glands

3 These are placed farther forward than the superior parathyroid glands and usually lie behind the lower pole of the thyroid gland and in front of the inferior thyroid artery and recurrent laryngeal nerve. Because of their close association with this nerve it is wise to identify it in every case before removing these glands. Sometimes these glands are embedded in the substance of the lower pole of the thyroid gland and sometimes they lie near the inferior thyroid artery and do not move forwards when the lobe of the thyroid gland is displaced forward and medially



Ectopic parathyroid tissue The posterior mediastinum

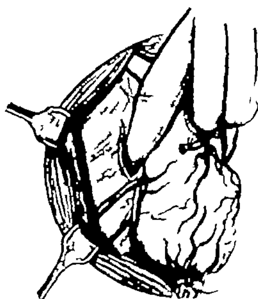
4 Numerous small islands of parathyroid tissue may be found in the connective tissue and fat of this region of the neck these may enlarge In addition one or more of the main parathyroid glands may be situated as high in the neck as the upper border of the thyroid cartilage or as low in the thorax as the groove between the aorta and the pulmonary artery The first step is to insert a finger into the posterior mediastinum on each side of the trachea and feel for any abnormal nodules. If one is located there it can be freed and drawn up into the neck because in many of these cases the blood supply comes from a branch of the inferior thyroid artery and once the parathyroid adenoma has been delivered into the cervical wound, the vascular pedicle can be tied with ease



The neck region

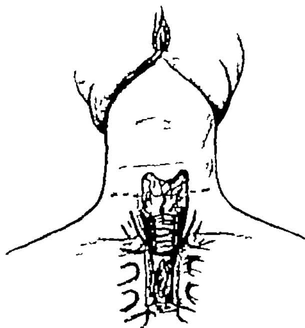
5 Having explored the normal sites, the region of the thyroid gland and the posterior mediastinum, the surgeon must search in the neck outside the false capsule of the thyroid gland and also in the thyroid gland itself before he can be sure that he has made a thorough search for a parathyroid tumour. Any nodule in the thyroid gland should be removed because parathyroid tissue may lie within the substance of this gland.

Further exploration of the neck is best carried out by making an incision through the false capsule of the thyroid gland (pre-tracheal layer of the deep cervical fascia) about 1 cm. above the inferior thyroid artery. The surgeon can then pass his finger behind this fascial plane and feel widely in the neck: this manoeuvre can then be repeated on the opposite side.



The anterior mediastinum

6 If a thorough search of the neck and upper part of the posterior mediastinum has failed to reveal the cause of the patient's hyperparathyroidism, then the superior mediastinum must be explored. This is best carried out through an upper midline sternotomy and with complete haemostasis a thorough search of this region made under direct vision. The sternotomy incision is performed in the way described for the exposure of a retrosternal goitre (see Part VIII, p. 21)



SPECIAL POST-OPERATIVE CARE

It is common for a period of hypoparathyroidism to follow removal of a hyperfunctioning parathyroid tumour or the subtotal resection of hyperplastic parathyroid tissue. It is wise to anticipate this by giving every patient by mouth calcium gluconate 20 mg. with vitamin D 500 000 units three times a day, or if symptoms develop 10 ml of a 10 per cent solution of calcium gluconate three times a day intravenously.

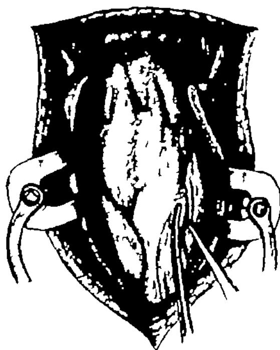
[*The illustrations for this Chapter on Exploration of the Parathyroid Glands were drawn by Mr. J. Wheldon.*]

Bibliography

Steiner, R. E., Fraser, R., and Aird, I. (1956). *Brit. med. J.*, **2**, 400

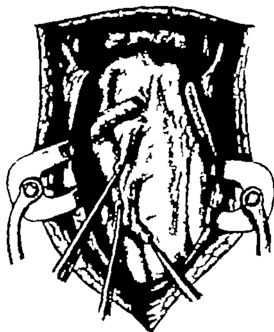
Mobilization of thymus

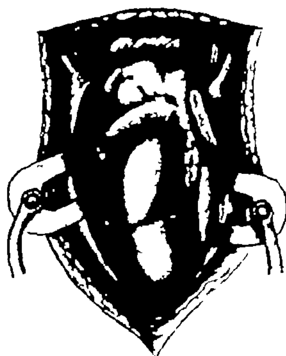
3 The edges of the two parts of the sternum are widely separated by a self-retaining retractor The H-shaped outline of the thymus is identified within the mediastinal fat, and the different poles of the organ are picked up by fine forceps. Blunt dissection by the use of small pledgets of gauze held in haemostats is preferable to cutting dissection because of the greater likelihood of opening the pleura with the latter procedure. Some cutting with scissors, however is often needed.



Removal of thymus

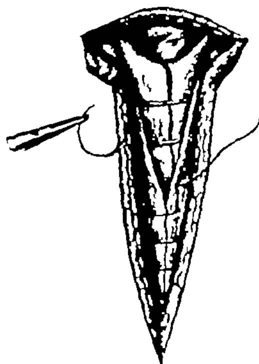
4 The principal arteries—which are, however small—enter the upper poles, while others come from the vessels accompanying the phrenic nerves. The main thymic vein drains into the left innominate vein—usually in or near the middle line it should be identified, cleared of fat and divided between ligatures. Thymic tissue ends indeterminably amongst the mediastinal and cervical fat and to ensure complete removal it is advisable to go well into these tissues especially at both poles, above and below





Final toilet

5 After removal of the thymus and some of the adjacent fat, the wound should be inspected thoroughly for small bleeding points which should be tied with fine ligatures. Small openings which may have occurred accidentally in the pleura should be identified, the lungs inflated to expel air from the pleura and the holes themselves closed—preferably by ligation



Closure

6 Several catgut strands of suitable strengths should be passed round—or through holes punched in—the sternum to lash its two parts together again The periosteum should be closed by interrupted catgut sutures, and the subcutaneous and deep fascia dealt with likewise Interrupted sutures are used for the skin. The small cervical incision should be closed as after thyroidectomy a small drainage tube being left in the pretracheal space for 48 hours Should the pleura have been opened and any doubts exist as to its closure siphon drainage—through a small lateral thoracotomy stab wound—must be provided.

TRANS-PLEURAL APPROACH

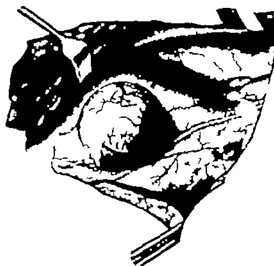
The incision

7 The left side of the chest has been opened by an incision through the fourth intercostal space. The superficial part of this incision should be sub-mammary in the female. The lung is allowed to fall back or is retracted backwards to expose the anterior mediastinum—in which in this case a small thymic tumour is seen in front of the line of the phrenic nerve.



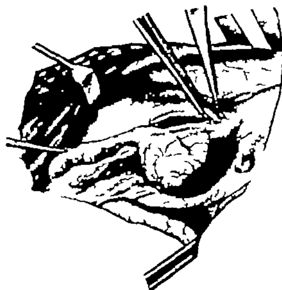
Exposure

8 A self-retaining retractor is used to hold the fourth and fifth ribs widely apart so that adequate access may be obtained for the subsequent dissection



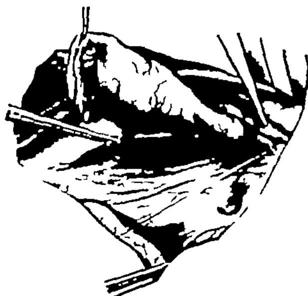
Dissection

9 The pleura over the thymus is incised and the gland identified within the mediastinal fat. Blunt dissection—with small pledgets of gauze held by haemostats—is preferable to cutting, but the latter is often necessary especially if there has been any previous inflammatory reaction in the vicinity and in older patients.



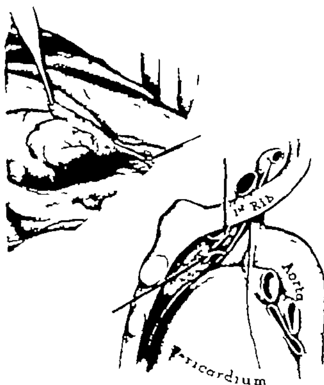
Mobilization

10 Small vessels reach the thymus from those accompanying the phrenic nerves but the main arterial supply is by small vessels entering the gland especially at its upper poles These should be dissected with care and the tissue just above them divided between ligatures.



Blood supply

11 The main venous drainage is by a single vein joining the left innominate vein it should be divided between ligatures also The lower arrow shows a branch of the internal mammary artery the thymic vein is indicated by the top arrow



Closure

12 The bed of the thymus calls for no special treatment after haemostasis has been achieved. A tube—for *siphon drainage*—is passed through the chest wall between two lower ribs *laterally*. The retractor is removed, the lungs expanded and the chest wall closed in layers as following any other such thoracotomy



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

At the conclusion of the operation, before the patient leaves the theatre, a radiograph must be made of the chest lest an unsuspected pneumothorax or atelectasis occurring during the operation be overlooked. Usually the wound heals rapidly and alternate skin sutures may be removed at the first dressing on the tenth day and the remainder 2–3 days later. The drains in the neck wound may be removed at the end of 48 hours. If the pleura has been opened and a siphon drain inserted this should be removed only when there is definite x-ray evidence of complete lung expansion. An oxygen tent—or an efficient oro-nasal oxygen mask—must be used for the first day or two at least, until it is obvious that the patient can breathe satisfactorily. Appropriate antibiotic therapy instituted before operation must be continued. Prostigmin must be given hypodermically at first and often larger doses are required during the early post-operative period than were necessary before. When the surgeon is satisfied that the patient is swallowing normally the administration of Prostigmin by mouth is resumed. Great care must be taken with respiratory sedatives.

Respiratory complications

These patients must be watched constantly and if need be radiographed repeatedly in case excessive bronchial secretion—due to Prostigmin—occurs or the patient fails to cough and keep the airway clear. Any suspicion of bubbling should lead to suction toilet of the trachea. If this is unsatisfactory or if there is atelectasis, bronchoscopic toilet must be done—repeatedly if necessary—without delay. Patients requiring high, and especially increasing, dosage of Prostigmin are very prone—post-operatively—to respiratory arrest and must be under constant skilled supervision. If it occurs the trachea must be intubated immediately and the patient manually ventilated until such time as a tracheostomy can be established and the patient connected to an automatic ventilating machine. Once a tracheostomy is established the airway must be kept clear of secretion and infection controlled by antibiotics. Prolonged intervals may be necessary before spontaneous respiration is resumed and the management of these cases can be very time-consuming and exhausting whilst Prostigmin stabilization is being established.

Deglutition

Deglutition may be difficult, or inability to achieve it may develop in those with respiratory difficulty feeding by a nasal gastric tube may have to be instituted.

[The illustrations for this Chapter on Thymectomy were drawn by Mr D P Hammersley]

EXPOSURE OF THE PITUITARY REGION BY THE FRONTAL APPROACH

G. K. TUTTON Ch.M., F.R.C.S.

University Lecturer in Neurosurgery Manchester Royal Infirmary

PRE-OPERATIVE

Indications

Visual deterioration, as shown by defects of fields of vision is the only absolute indication.

Headache due to sellar distension, growth and metabolic and sexual changes, are not by themselves definite indications except in certain cases of early and rapidly progressive acromegaly

The aim of operation is to relieve pressure on the optic nerves and chiasm, and thus restore vision. Exploration may be the only method of detecting a small suprasellar meningioma causing progressive monocular blindness.

Some tumours, notably certain carcinomas of the breast or prostate, are endocrine-dependent. In selected cases ablation of the pituitary gland produces worth-while but temporary improvement.

Special contra-indications

The dangers in operating on tumours in the chiasmal region are due first to an upward extension towards the hypothalamus, and secondly to the effect of an operation in the presence of profound pituitary insufficiency Clinically these complications can be suspected when excessive sleepiness and attacks of coma occur in the former and listlessness, subnormal temperature, low blood pressure, changes in skin or hair growth, and personality changes are marked in the latter

Whilst operation in the elderly is not a definite contra-indication since retraction of the frontal lobe is facilitated by slight atrophic changes, complete blindness with absent light perception is a definite contra-indication probably at any age. The presence of severe arteriosclerosis may be a deciding factor in advising against operation where visual acuity has been very slowly declining over several years and is grossly impaired, because useful recovery is problematical.

Special pre-operative investigations and preparation

Air encephalography by fractional lumbar route is essential in all cases, in order to demonstrate the extent and size of extra-sellar extension, with particular reference to distortion of floor of third ventricle. Carotid angiograph has only a limited use.

Routine biochemical estimations of gonadotrophins and ketosteroids may help in deciding the degree of pitui... and adrenal activity In obvious cases of insufficiency cortisone (50 mg per day) is indicated. Response to cortison is usually dramatic, and has given greater confidence when dealing with these dangerous cases.

Premedication

Phenobarbitone (3 gr) should be given the night before the operation. Atropine ($\frac{1}{100}$ gr) and a dose of suitab' analgesic not large enough seriously to depress respiration should also be given. Heroin in doses of $\frac{1}{12}$ – [illegible] gr suggested, the dose varying with the patient's physique and probable resistance to sedative drugs.

Anaesthesia

General anaesthesia with an endotracheal tube is employed in the great majority of cases. Local anaesthesia can b used exceptionally where difficulty with the airway and consequent raising of intracranial pressure is likely to occ

A smooth anaesthetic with complete avoidance of coughing or straining at any stage is essential. Swelling of the brain after such an episode can prevent adequate exposure of the chiasm unless dangerously vigorous retraction is employed. Ether or Trilene may also cause brain swelling and should not be used. Topical anaesthesia of the trachea and larynx will go far to prevent coughing If retraction of the frontal lobe is difficult, and improvement after tapping the ventricle does not occur it is wiser to close the wound and re-operate another day perhaps under local anaesthesia. At all stages of the operation the anaesthetist should chart the pulse respiration and blood pressure. It is his duty to inform the surgeon immediately of changes in these, since the most likely cause is retraction of the frontal lobe producing indirect pressure on the hypothalamus through a suprasellar extension. Induced hypotension prevents the appearance of blood pressure changes, and should not be employed.

Some surgeons employ continuous drainage of the cerebrospinal fluid through a lumbar puncture needle to aid ease and safety of retraction. Good anaesthesia alone will provide an adequately low intracranial pressure.

Position of patient

The patient lies on the back with the head slightly raised. The elevation of the bone flap is facilitated by turning the head a little to the left. Before retraction of the frontal lobe commences, the head should be placed again in the mid position to avoid an oblique view of the nerves and the chiasm.

TOTAL HYPOPHYSECTOMY

Total hypophysectomy has been tried as the primary procedure in advanced secondary mammary carcinoma, or in recurrence after adrenalectomy and ovariectomy

Pre-operative

The skull and chest are examined by x-rays. A pleural effusion may prejudice the use of anaesthesia. Full electrolyte and blood chemistry estimations are made and cortisone is given, 200 mg., 12 hours before operation.

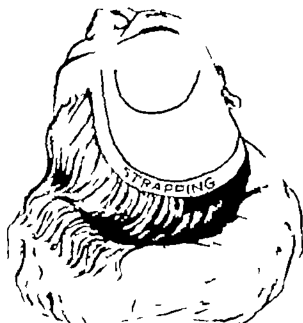
Operative technique

Exposure is best achieved through a right frontal flap Care is taken to cut the flap as low as possible and the dura is widely opened to allow elevation of the frontal lobe. To identify the pituitary stalk, both optic nerves and the anterior part of the chiasm must be clearly seen A lighted retractor is essential. Very rarely a prefixed optic chiasm will prevent this, and the operation must be abandoned, because the distance between the two optic nerves is too narrow The stalk is divided after application of a silver clip and hook coagulation. Section is made as near to the diaphragma sellae as possible, to sever the blood supply to the pituitary through the portal system in the stalk. The hole in the diaphragm is enlarged anteriorly A patty is tucked back under the chiasm to prevent extravasation of blood in front of the pons. The pituitary fossa is then curetted with suitable special small spoons. In some cases the anterior bony ridge of the tuberculum sellae may have to be chiselled away after stripping the dura off the interclinoid bar before this can be done. Venous bleeding may be profuse As much pituitary tissue as possible is removed, then Zenker s solution is instilled through a small polythene tube great care is taken to protect the optic nerves from overspill The dura mater may be left open if there is any swelling of the frontal lobe

THE OPERATION

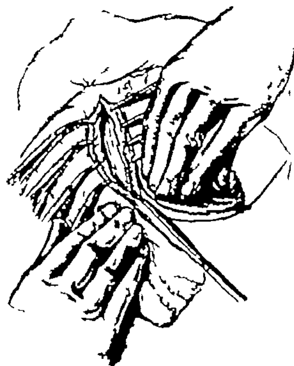
The incision

1 The incision is marked lightly with a knife after the skin has been cleaned with antiseptic solutions. A useful regime is Hydrargyri Perchloridum (B P) (1 1 000) followed by spirit and iodine Local anaesthetic (amethocaine 0 1 per cent) with addition of adrenaline (1 100 000) is used to lessen bleeding Thorough infiltration of the temporal muscle is essential The skin incision should be above the hair line except on the forehead where the midline is very carefully measured to give a cosmetically perfect scar



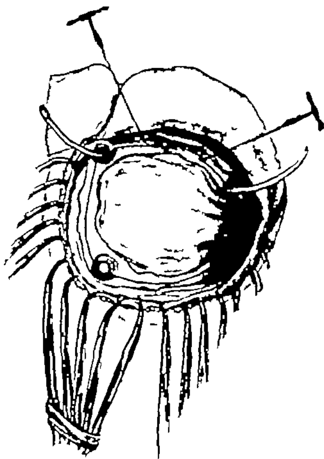
Surgical cleanliness

2 Surgical cleanliness is aided by stitching a lint guard soaked in perchloride around the incision Fingering the skin is to be avoided. The scalp is incised cleanly over a length which can be controlled by digital pressure On the forehead it is an advantage to carry the incision through the periosteum immediately so that the midline is clearly marked. Elsewhere the pericranium and temporal fascia are divided separately Artery forceps (curved for scalp and straight for flap side) are applied to the galea at 1-2 cm. intervals and loosely fastened together in bundles of five or less. Large vessels may be picked up separately and coagulated.



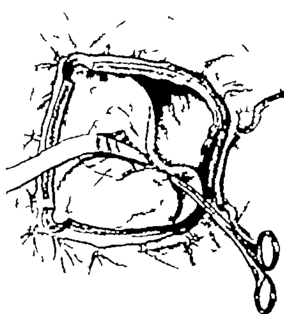
Bone flap

3 A small four-hole bone flap is cut after incising the periosteum. Along the medial side this should be about 1 cm. from the midline to avoid damage to the longitudinal sinus. A Gigli guide is inserted between burr holes after separating the dura with a curved Adson's dural elevator. If the dura is adherent to the bone a further burr hole should be made. The saw cuts are fashioned to give a slight bevel on the bone edges in order to prevent sinking in of the flap after closure. The temporal burr holes are not connected with the saw and fracture of the bone in elevation is aided by nibbling for 1–2 cm.



Stripping and incision of the dura

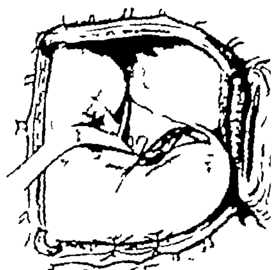
4 After arresting haemorrhage on the dura, usually from the torn middle meningeal artery (bone wax is often useful) clean towels are clipped to the skin edges and extradural elevation of the frontal lobe commenced. The dura strips easily by wool pledget and blunt dissection off the orbital roof, but finally sticks at its attachment to the sphenoidal wing. This stripping should be taken well medially. With the head now in mid-position the dura is incised 0.5 cm. above its attachment. Cerebrospinal fluid in considerable quantity escapes; this facilitates subsequent retraction. Dural scissors are now used to cut dura along the wing medially, the cortex being protected with patties. Some surgeons prefer the intradural route for the whole operation.



Elevation of frontal lobe

5 The dura is incised medially along the wing until the white glistening olfactory nerve is seen. This is carefully preserved from excessive traction with patties, and the cut carried anteriorly parallel to it. A lighted retractor is a help at this stage The frontal lobe protected with patties, is gently elevated and retracted until the optic nerve is seen The key to its situation lies in following the direction of the olfactory nerve When first seen the optic nerve is ensheathed in filmy arachnoid investing the cisterna chiasmatica. The continuous removal of cerebrospinal fluid through a polythene sucker lying in the cisterna chiasmatica greatly facilitates the exposure.

Inset —Hitch sutures placed between dura and pericranium control the extradural venous ooze which can be most troublesome.



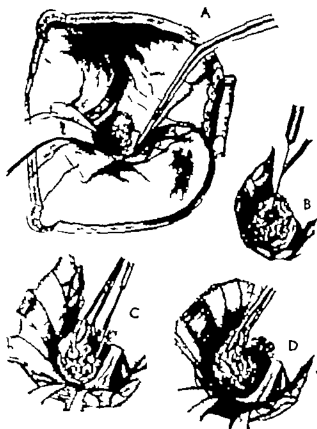


Removal of a pituitary adenoma

6 (A) Exposure of the tumour rising up between the optic nerves is obtained by dissection of arachnoid from its surface and a steady retraction of the frontal lobe with the left hand. Only sufficient room to enable manipulation of instruments is necessary Attempts to see the extent of the lesion in its entirety are not permissible at this stage and may be highly dangerous.

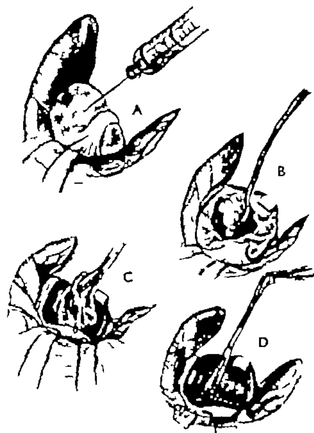
(B) After coagulation of a small area on the capsule, a needle attached to a 5 ml syringe is inserted and steadied whilst the assistant attempts aspiration. The further procedures depend on the consistency of the tumour which is (C) incised, (D) curetted, sucked or punched out. No attempt is made to remove the capsule. The aim is to relieve all pressure on the nerves. Haemorrhage from the cavity is controlled with small patties, fibrin foam and patience





Removal of a small suprasellar meningioma

7 (A) As the optic nerve is approached the tumour may first be seen covered with filmy arachnoid. Again maintenance of steady retraction is essential. Identification of right optic nerve and carotid artery (seen in the bottom two pictures running obliquely laterally) is important at all stages of the subsequent removal. This can be complete, and done wholly or piecemeal after (B) coagulation of the tumour surface. (C) and (D) Separation of the site of attachment usually on the tuberculum sellae, at a very early stage is desirable. The final removal of the postero-medial part of the tumour is done very gently to avoid damage to the chiasm hypothalamus, pituitary stalk and anterior cerebral arteries. Considerable judgment and skilled assistance is required in these cases.

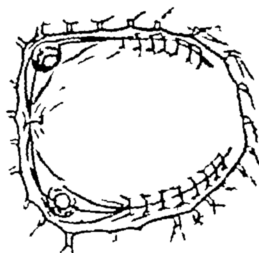


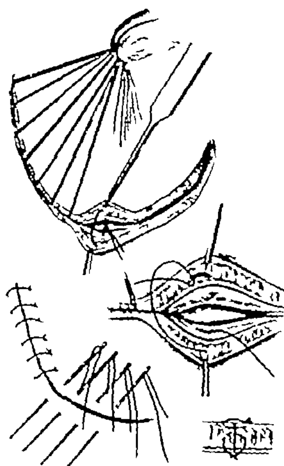
Appearance and removal of Rathke s pouch tumour

8 (A) A Rathke s pouch tumour is usually cystic in part (note the cholesterol crystals shimmering in the cyst aspirate) this may tempt the surgeon to carry out a complete removal Backward extension above and behind the chiasm is extremely hazardous. Usually only a piece of the cyst wall is taken for biopsy since emptying of the cyst alone may give excellent long-term results. (B) It is usually necessary to cut one optic nerve. In this instance the right has been cut. (C) Note how the chiasmal end retracts and allows exposure of the carotid artery The dissection follows similar steps to that for a meningioma. (D) A nubbin of tumour is being removed from beside the pituitary stalk

Closure of the bone flap

9 Silk or black thread sutures, preferably waxed, are used throughout. It is important to suture the cut temporal muscles on each side and put in some dural hitch sutures if oozing is troublesome. No attempt is made to suture the dura on the wing but if the intradural route has been followed it should be accurately closed. Drainage of the sella or chiasmal region is best avoided. Fibrin foam is most useful in the extradural space. The drawing shows the bone flap replaced and held in position with pericranial and temporal fascia sutures. Bone dust from the burr holes may be packed into the medial two holes to prevent unsightly retraction later.





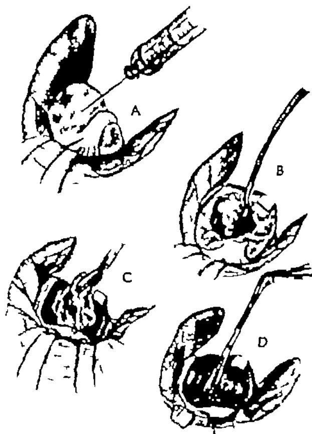
Closure of the skin in two layers without drainage

10 Note the method of inserting the deep sutures which should include half the skin thickness and galea. Inversion so that the knot lies on the deep surface makes later extrusion much less likely. Spacing of deep sutures should be at 1–2 cm intervals. The aim of these sutures is haemostasis and exact apposition of skin edges, so that skin sutures are not under any tension.



Removal of a small suprasellar meningioma

7 (A) As the optic nerve is approached the tumour may first be seen covered with filmy arachnoid. Again maintenance of steady retraction is essential. Identification of right optic nerve and carotid artery (seen in the bottom two pictures running obliquely laterally) is important at all stages of the subsequent removal. This can be complete, and done wholly or piecemeal after (B) coagulation of the tumour surface (C) and (D) Separation of the site of attachment, usually on the tuberculum sellae, at a very early stage is desirable. The final removal of the postero-medial part of the tumour is done very gently to avoid damage to the chiasm, hypothalamus, pituitary stalk and anterior cerebral arteries. Considerable judgment and skilled assistance is required in these cases.

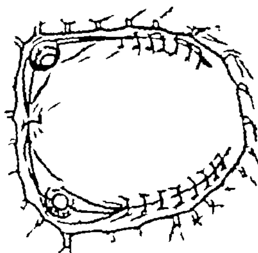


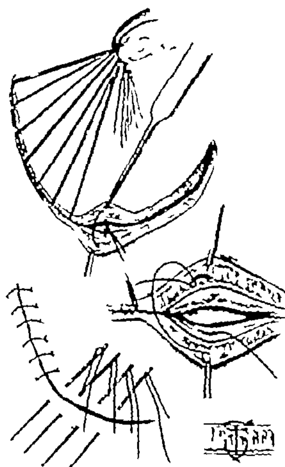
Appearance and removal of Rathke s pouch tumour

8 (A) A Rathke s pouch tumour is usually cystic in part (note the cholesterol crystals shimmering in the cyst aspirate) this may tempt the surgeon to carry out a complete removal Backward extension above and behind the chiasm is extremely hazardous. Usually only a piece of the cyst wall is taken for biopsy since emptying of the cyst alone may give excellent long-term results. (B) It is usually necessary to cut one optic nerve. In this instance the right has been cut. (C) Note how the chiasmal end retracts and allows exposure of the carotid artery The dissection follows similar steps to that for a meningioma (D) A nubbin of tumour is being removed from beside the pituitary stalk

Closure of the bone flap

9 Silk or black thread sutures, preferably waxed, are used throughout. It is important to suture the cut temporal muscles on each side and put in some dural hitch sutures if oozing is troublesome. No attempt is made to suture the dura on the wing but if the intradural route has been followed it should be accurately closed. Drainage of the sella or chiasmal region is best avoided. Fibrin foam is most useful in the extradural space. The drawing shows the bone flap replaced and held in position with pericranial and temporal fascia sutures. Bone dust from the burr holes may be packed into the medial two holes to prevent *unsightly retraction later*.



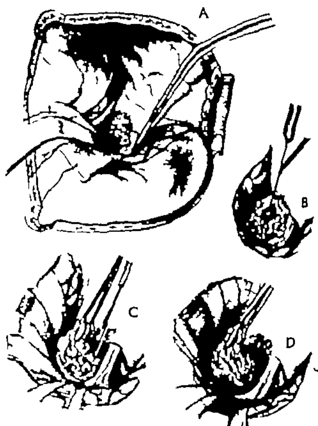


Closure of the skin in two layers without drainage

10 Note the method of inserting the deep sutures which should include half the skin thickness and galea. Inversion, so that the knot lies on the deep surface makes later extrusion much less likely. Spacing of deep sutures should be at 1–2 cm. intervals. The aim of these sutures is haemostasis and exact apposition of skin edges, so that skin sutures are not under any tension.

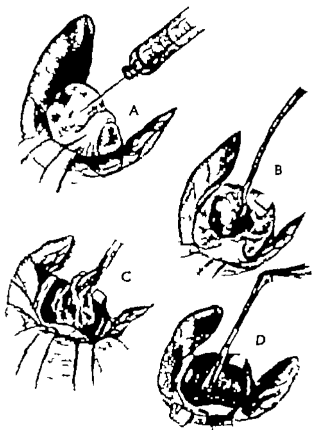
Removal of a small suprasellar meningioma

7 (A) As the optic nerve is approached the tumour may first be seen covered with filmy arachnoid. Again maintenance of steady retraction is essential. Identification of right optic nerve and carotid artery (seen in the bottom two pictures running obliquely laterally) is important at all stages of the subsequent removal. This can be complete, and done wholly or piecemeal after (B) coagulation of the tumour surface. (C) and (D) Separation of the site of attachment, usually on the tuberculum sellae at a very early stage is desirable. The final removal of the postero-medial part of the tumour is done very gently to avoid damage to the chiasm, hypothalamus, pituitary stalk and anterior cerebral arteries. Considerable judgment and skilled assistance is required in these cases.



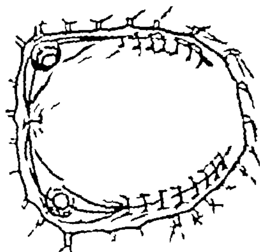
Appearance and removal of Rathke's pouch tumour

8 (A) A Rathke's pouch tumour is usually cystic in part (note the cholesterol crystals shimmering in the cyst aspirate) this may tempt the surgeon to carry out a complete removal. Backward extension above and behind the chiasm is extremely hazardous. Usually only a piece of the cyst wall is taken for biopsy since emptying of the cyst alone may give excellent long-term results. (B) It is usually necessary to cut one optic nerve. In this instance the right has been cut. (C) Note how the chiasmal end retracts and allows exposure of the carotid artery. The dissection follows similar steps to that for a meningioma. (D) A nubbin of tumour is being removed from beside the pituitary stalk.



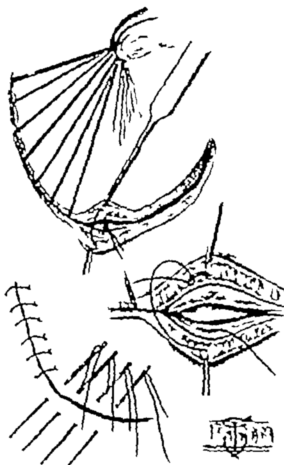
Closure of the bone flap

9 Silk or black thread sutures, preferably waxed, are used throughout. It is important to suture the cut temporal muscles on each side and put in some dural hitch sutures if oozing is troublesome. No attempt is made to suture the dura on the wing but if the intradural route has been followed it should be accurately closed. Drainage of the sella or chiasmal region is best avoided. Fibrin foam is most useful in the extradural space. The drawing shows the bone flap replaced and held in position with pericranial and temporal fascia sutures. Bone dust from the burr holes may be packed into the medial two holes to prevent unsightly retraction later.



Closure of the skin in two layers without drainage

10 Note the method of inserting the deep sutures which should include half the skin thickness and galea. Inversion so that the knot lies on the deep surface makes later extrusion much less likely. Spacing of deep sutures should be at 1–2 cm. intervals. The aim of these sutures is haemostasis and exact apposition of skin edges, so that skin sutures are not under any tension.



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Ideally the anaesthesia should be such that the patient recovers consciousness before leaving the operating theatre, so that the state of responsiveness can be established. If all goes well sutures are removed on the fourth post-operative day Inspection on the first post-operative day and aspiration of free subgaleal blood is wise.

Immediate complications

Post-operative clot compression

The low intracranial tension in the immediate post-operative period renders these cases liable to develop a clot. A diminishing state of responsiveness is the clue, and it is wiser to reopen the flap under local anaesthesia in cases of doubt.

Blood pressure

Hypothalamic upset which may be temporary or fatal in 12–24 hours, is manifested by a low blood pressure, rapid pulse and a rising temperature, with a diminished state of consciousness.

Treatment by tepid sponging Coramine, Eucortone and vasopressors should be instituted immediately

Diabetes insipidus

Diabetes insipidus may be an early or late special complication. Excessive diuresis and restlessness, occasionally accompanied by disorientation and euphoria, are indications for daily injections of Pitressin Tannate in dosage according to weight. Adequate fluid intake to maintain an electrolyte balance is of the greatest importance.

Cerebral oedema

Cerebral oedema may occur as a result of injudicious retraction. If dangerous compression occurs, removal of the bone flap which may be placed in a deep freeze for insertion later is indicated.

Pituitary cachexia can occur at any stage in the post-operative period, and should be treated by cortisone (50 or 100 mg per day) later reduced to the patient s minimum requirement and continued indefinitely

TOTAL HYPOPHYSECTOMY

Cortisone, 200 mg per day is given for the first week, and then gradually reduced to 50 mg or less per day It is possible that this dose of cortisone is unnecessary Major alterations in electrolyte balance and particularly chloride excretion do not seem to occur as with adrenalectomy cases. Diabetes insipidus which can be controlled with 1 ml. of Pitressin Tannate, is usual but not invariable Epileptic attacks can occur phenobarbitone, 1 gr twice daily should be given routinely Pulmonary complications are particularly to be guarded against and constitute the main hazard of this operation.

[The illustrations for this Chapter on Exposure of the Pituitary Region by the Frontal Approach were drawn by Miss Dorothy Davison]

INTERSTITIAL IRRADIATION OF PITUITARY

W P GREENING, F R C S

Surgeon Royal Marsden Hospital London Surgeon Charing Cross Hospital London

PRE-OPERATIVE

Indications

Malignant disease

In the present state of our knowledge the main indication is advanced or disseminated cancer of the breast or prostate where a significant remission cannot be expected from any other method of treatment. This operation can only be regarded as palliative in advanced cancer

Endocrine disorders

Other conditions such as certain forms of diabetes, Cushing s disease and exophthalmic ophthalmoplegia may be improved by this method of treatment but cannot as yet be strictly regarded as indications for it.

Special contra-indications

No patient should be turned down on the grounds of unfitness for operation providing there is a reasonable chance of producing a remission. Hopelessly advanced cases in the terminal stages should not, of course, be subjected to any form of surgical or radiotherapeutic intervention

Pre-operative investigations

(1) Complete x-ray examination of the chest and the skeleton.
(2) Iodine uptake studies.
(3) Urinary estimations of the following
  (*a*) Pituitary gonadotrophins.
  (*b*) 17 Ketosteroid.
  (*c*) Quantitative oestrogen assay
  (*d*) Mammatrophin
(4) Water load test.
(5) Blood chemistry—sodium, potassium chlorine urea, acid and alkaline phosphatase and cholesterol

Aim of the operation

The aim is to insert accurately into the pituitary gland two rods of radio-active yttrium one just to the right and one just to the left of the midline In order to achieve total destruction of the pituitary gland it is necessary to use beta irradiation. Yttrium 90 is the best source having a half life of 2 7 days It is used in the form of an oxide and made up into rods 1 3 mm in diameter and 5 mm long This gives a uniform dose from two sources extending to 11 mm Gold 198 when unscreened needs three sources to produce a uniform dose and is therefore not so satisfactory

Special pre-operative preparation

Three days before the operation the patient is given a course of penicillin and streptomycin nasal drops or spray On the day of the operation a prophylactic course of penicillin and streptomycin is started.

Anaesthesia

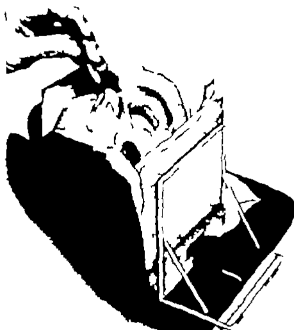
No special precautions are taken apart from the usual intubation with a cuffed tube

THE OPERATION

The table

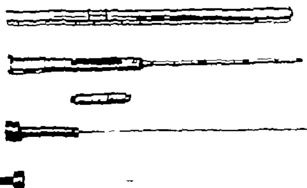
1 A special table is used with clamps to ensure correct antero-posterior positioning and fixation of the head

The nose is packed with 8 per cent cocaine and adrenaline, to shrink the mucosa and minimize haemorrhage.



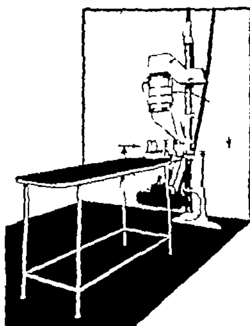
The needle

2 A small calibre rigid needle is used with magazine attachment and introducing stilettes.



The image intensifier

3 The image intensifier and x ray tube are mounted so that they can be rotated in order to obtain both antero-posterior and lateral views of the skull. Use of the image intensifier allows *for adequate visualization of the* pituitary fossa in daylight and at the same time does not subject the patient or the surgeon to a significant radiation dosage



4

Insertion of needle

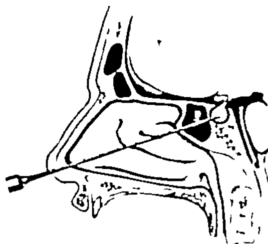
The needle is inserted through the nostril as far as the sphenoidal air sinus, slightly to the left of the midline. When the needle has reached the sphenoidal air sinus, its position, in the lateral view is checked by the image intensifier



5

Passage through the sphenoidal air sinus

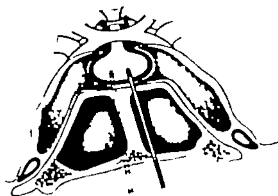
If the needle is seen to be correctly aligned, it is pushed or gently hammered through the sphenoidal air sinus to the base of the sella turcica when its position is again checked in the lateral and antero-posterior views.



6

Insertion of rods

Only when this is completely satisfactory is the needle hammered into the sella turcica and the first yttrium rod inserted. This will act as a marker for positioning the remaining rod. It may be possible to insert the remaining rod through the same nostril, but if this is technically difficult, the needle is removed and introduced through the opposite side of the nose. After the rods have been inserted and the needle removed, any blood is sucked out of the nasopharynx and the nose is lightly packed with gauze



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Penicillin is continued for 4 days after the operation. The packing is removed in 96 hours.

Addisonian symptoms

If there has been complete destruction of the pituitary the patient should, within 8 weeks, develop addisonian symptoms. These are adequately treated with 25 mg of cortisone daily This is, in point of fact, the only satisfactory test for complete pituitary ablation it should be watched for carefully and treated immediately it arises.

Myxoedema

Myxoedema takes longer to develop and when it does occur can easily be treated by the administration of thyroxine

Optic chiasma

With the extreme accuracy of this method, damage to the optic chiasma should not occur

Post-operative meningitis and cerebrospinal rhinorrhoea

These are rare complications which probably cannot be completely avoided and must be regarded as an ever present risk.

[The illustrations for this Chapter on Interstitial Irradiation of Pituitary were drawn by Miss June Allister]

Bibliography

Mallard, J R., McKinnell, A. and Francois, P E. (1956) "Seeds of Pure β-ray emitter (yttrium-90) for Radiation Hypophysectomy" *Nature Lond.*, 178, 1240

Rasmussen, T B Harper P V., Yuhl, E and Bergenstal, D M. (1955). *The Destruction of the Pituitary Gland in Metastatic Cancer with Yttrium 90 Pellets* Argone Cancer Research Hospital Semi-Annual Report to the U.S Atomic Energy Commission.

EXPOSURE AND RESECTION OF ADRENAL GLAND FOR TUMOUR

TRANS-DIAPHRAGMATIC APPROACH

J SETON PRINGLE, F.R.C.S. (I) AND (ENG.)
Professor of Surgery Royal College of Surgeons in Ireland

PRE-OPERATIVE

Indications

Occasionally a non-active tumour may present for removal but most adrenal tumours are associated with hyperactivity either of the cortex (Cushing's syndrome or adrenogenital syndrome) or of the medulla (phaeochromocytoma) and these will present different problems in management.

Contra-indications

Clinical evidence of malignancy with metastasis is a contra-indication to operation.

Access

Removal by a trans-diaphragmatic approach is shown but the alternative routes, particularly the abdominal, are very commonly employed, especially in the case of phaeochromocytomas when the tumour may lie away from the adrenals along the aorta and sympathetic chain, and is bilateral in about 10 per cent of cases.

In cases where the tumour has not been localized to one side by palpation, pyelogram or peri-renal pneumography the abdominal approach must be used.

Special pre-operative preparation

Cushing's syndrome

Most cases of Cushing's syndrome with cortical tumours are associated with some degree of atrophy of the other adrenal and substitute therapy is therefore necessary Cortisone 100 mg., should be given by injection 24 hours before operation and again 1 hour before operation On the day before operation 5 g. of salt may be given. In cortical tumours with adrenogenital syndrome substitute therapy may not be necessary but it is wise to give cortisone before operation.

Phaeochromocytoma

During operation, manipulation of the tumour releases adrenaline into the circulation and may produce a marked rise in the blood pressure This rise may be controlled, if necessary by adrenolytic drugs for example Piperoxane or Regitine (in an adult 5 mg intravenously repeated as required)

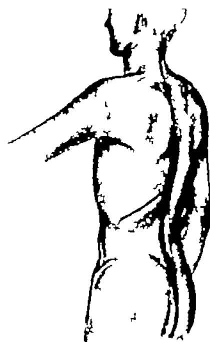
The fall in blood pressure following the removal of the tumour can be controlled by an intravenous drip containing 2 mg. noradrenaline per 100 ml., regulating the flow as required.

Anaesthesia

Positive-pressure intratracheal anaesthesia is essential as the pleura is opened.

Position of patient

The patient is placed on the contra-lateral side in the renal position but no kidney rest is used.

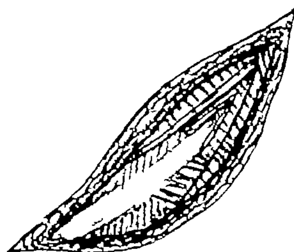


THE OPERATION

The incision

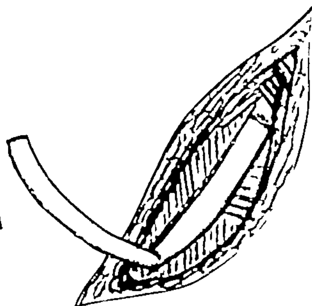
1 An incision is made about 6 inches long over the eleventh rib, commencing about 2 inches from the midline posteriorly

(If the lumbar approach is preferred, the incision is made over the twelfth rib which is resected, rather than below the rib)



Exposure of the trapezius

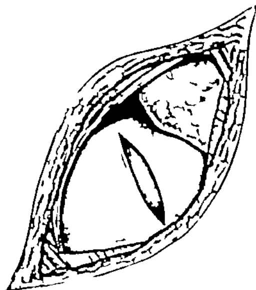
2 The latissimus dorsi lies deep to the skin and subcutaneous tissue and is cut through The trapezius is seen at the back of the incision but need not be cut. The sacro-spinalis is now seen posteriorly and fibres of the serratus posterior inferior are cut to clear the eleventh rib lateral to this muscle A diathermy can be used to cut the muscles.



3

Exposure of the pleura

The eleventh rib is removed from tip to angle The subcostal vessels, which were lying under the border of the rib are now seen but should not be damaged. The pleura is exposed and opened along the bed of the rib



4

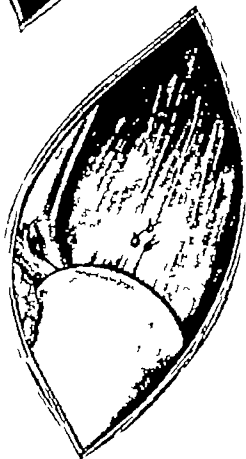
Exposure of the diaphragm

After the pleura has been opened the lung normally retracts to expose the diaphragm but if adhesions are present at the base of the lung they must be divided to free the lung An incision 5 or 6 inches long is made in the diaphragm running upwards over the dome of the diaphragm parallel to the muscle fibres. The peritoneum covering the under surface of the diaphragm should not be opened.



Dissection of the tumour

5 The tumour may present when the diaphragm is opened. The peritoneum covering the anterior surface of the tumour is pushed forwards. Variations in the size and shape of the tumour will materially affect its relationship to the surrounding organs. The tumour must be gradually dissected free, ligating vessels as they appear Temporary plugging of the wound will sometimes be of value to control bleeding.



Tumour cavity following excision

Left side

6 The bed of the tumour after its removal shows the relationship of the growth to surrounding organs The peritoneum of the lesser sac lies in front, with the tail of the pancreas below in front of the renal vessels The aorta runs downwards on the medial side The diaphragm lies behind and the upper pole of the kidney laterally



7 *Right side*

The liver lies medially above and in front Laterally lies the upper pole of the right kidney and below the renal vessels with the peritoneum and the duodenum in front. The inferior vena cava lies medially and the diaphragm behind.



8 **Closure**

The diaphragm is sutured. Either catgut or some unabsorbable suture may be used Before the pleura is completely closed by suturing of the covering muscles, the anaesthetist inflates the lung by positive pressure No drainage is required.

SPECIAL POST-OPERATIVE CARE

approach through the chest normally gives rise to no special complications but it may be followed by a effusion which may require aspiration or by a collapse of the lower lobe of the lung

. transfusion

d transfusions should be started during operation if there is any serious blood loss and continued after on.

ochromocytoma

noradrenaline drip can usually be stopped shortly after operation but it may need to be continued for several ortisone will be required where there is a bilateral tumour

ng's syndrome

ral litres of 5 per cent glucose should be given intravenously in the first 24 hours.
isone, 100 mg is given 6-hourly by mouth after operation but the dose can gradually be reduced and it can e stopped completely in 4–5 days.
generally not necessary to add extra salt to the daily diet.

illustrations for this Chapter on Exposure and Resection of Adrenal Gland for Tumour were drawn by Mr J Wheldon 'ginals by Dr Stella Henry]

SUBTOTAL ADRENALECTOMY
ABDOMINAL APPROACH

J Seton Pringle, FRCS (I) and (Eng)
Professor of Surgery Royal College of Surgeons in Ireland

PRE-OPERATIVE

Indications

Subtotal adrenalectomy is now being done for cases of Cushing's syndrome with bilateral adrenal hyperplasia but without an adrenal tumour One adrenal is removed completely and the second adrenal is partially resected in an attempt to reduce adrenal cortical function to a normal level No final judgment of results can yet be made but reports are encouraging

It is difficult to gauge the amount to be resected but at least 90 per cent of the second gland must be removed as resection of a lesser amount is generally ineffectual, and if too little gland is left the patient must be subsequently maintained on cortisone. On the other hand some surgeons prefer total adrenalectomy because of the possibility of recurrence after the subtotal operation.

Subtotal adrenalectomy has also been suggested for severe essential hypertension, sometimes in association with sympathectomy but its value for this is at present uncertain

Access

The abdominal approach is described and it has the advantage that both adrenals are accessible. It may be employed for preliminary examination of the glands and surrounding area of the posterior abdominal wall even though removal may subsequently be done through the lumbar route in cases, for example where the obesity of the patient would make abdominal removal difficult.

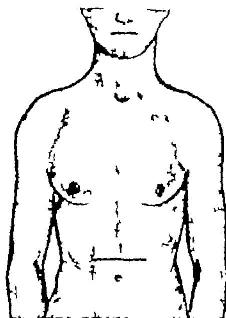
A transverse incision is best, though a long vertical incision can also be used

Special pre-operative preparation

Cortisone 100 mg., is given 24 hours before operation and again 1 hour before operation, by injection 5 g of salt should be added to the last day's diet.

Anaesthesia and position of patient

These are as for any major abdominal operation. Good muscle relaxation is essential.



THE OPERATION

Incision

1 A transverse incision is made about 6 inches long and sited 2 inches above the umbilicus. In patients with a narrow sub-costal angle the outer ends of the incision may curve downwards.

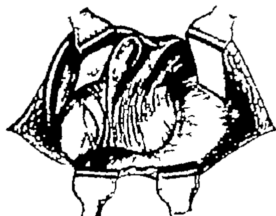
Division of muscles

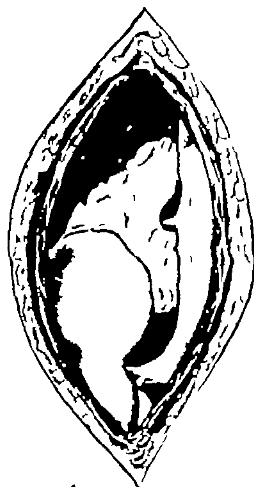
2 Deep to the skin and subcutaneous tissue the anterior rectus sheath is opened in the line of the incision to expose the rectus muscle on each side and these muscles are divided. Muscular branches may bleed profusely and if ligatures tend to tear out of the muscles the vessels should be controlled by understitching. Diathermy is used by some surgeons to cut the muscles. The posterior rectus sheath and peritoneum are now opened together to give an exposure of both sides of the upper abdomen. Exposure of the supra-renal on each side must now be considered separately.



Exposure of right supra-renal gland

3 Three or four deep retractors are necessary to obtain satisfactory exposure. The liver must be retracted upwards and this may be helped by division of the falciform ligament. The stomach and duodenum are displaced medially and the transverse colon retracted downwards. The upper pole of the kidney is palpated and pushed downwards and the peritoneum is opened over its medial side. This exposes the supra-renal gland.

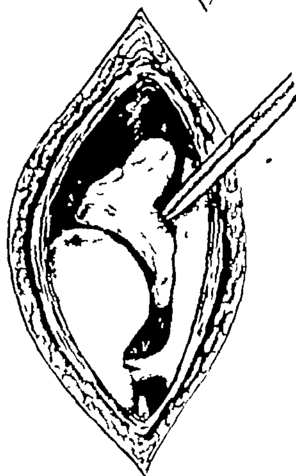




4

Relation to inferior vena cava

The supra-renal is cleared from the surrounding fatty tissue and its relation to the inferior vena cava clearly defined. Traction may be made on the gland with peritoneal forceps but care must be taken as the gland may tear easily



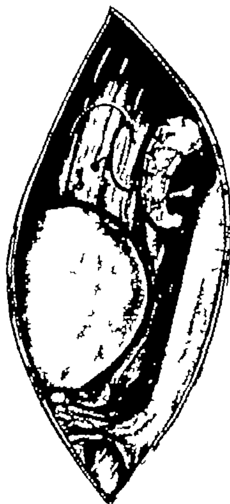
5

Freeing the gland

Arterial branches, which are variable in number run to the gland from the diaphragm, the renal artery and the aorta. These may be controlled by ligatures or silver clips, but the arteries often break up into very small branches before entering the supra-renal gland so that it may be separated by sharp dissection without serious arterial haemorrhage

Supra-renal vein

The lateral surface of the gland is first separated and then the fascia joining the gland to the inferior vena cava on the inner side is cleared, to expose the supra-renal vein entering the inferior vena cava from the front of the gland This vein is ligated but it may be short and care must be taken as a serious haemorrhage may result if the vena cava is torn or a ligature slips off the vessel. The lower pole is freed, and separation of the upper pole which may run behind the inferior vena cava completes the removal

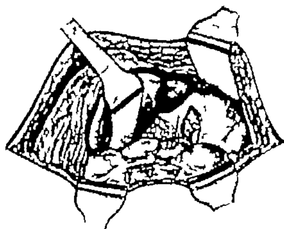


Excision of gland

6 On one side a small portion of the gland is left behind. The slip is left beside the supra-renal vein. The right side is shown here but it is immaterial which side is chosen.

Only about 10 per cent of the gland should be left behind and if the amount is to be accurately assessed, the gland must be fully mobilized and a clear field obtained, if necessary by temporarily plugging the area with gauze to counteract oozing

The cut surface may be overstitched to control bleeding but stitches easily cut through the friable gland and are generally unnecessary

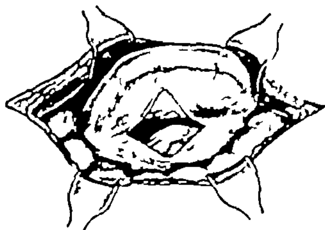


Exposure of left supra-renal gland

7 As on the right side, deep retractors are necessary to obtain a satisfactory exposure. The spleen is pulled medially and the peritoneum and underlying fascia are cut vertically along the inner side of the upper pole of the left kidney This mobilizes the spleen which can now be drawn farther over to the right, bringing the tail of the pancreas with it. The left supra-renal is now exposed, medial to the pole of the kidney and overlying it.

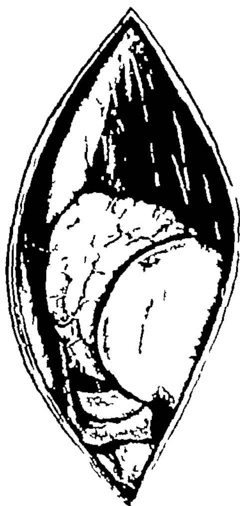
8 *Alternative approach*

The left supra-renal may also be reached through the gastrocolic omentum The greater omentum is opened widely on the left side and, crossing the lesser sac the posterior peritoneum is opened and the tail of the pancreas retracted



9 **Finding the gland**

Should there be any difficulty in finding the gland, it can be palpated as a firm mass but it is generally easily recognized by its characteristic yellow-brown colour

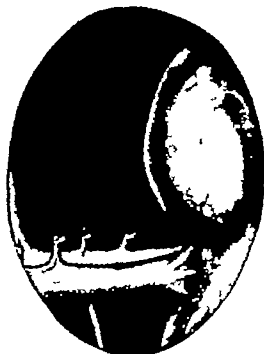


Arterial branches and supra-renal vein

10 Arterial branches from the aorta and diaphragm, which are variable in size and number are cut and controlled if necessary

The supra renal vein running into the left renal vein (occasionally into the vena cava) is defined and ligated. If the supra-renal vein is torn on either side the haemorrhage may obscure vision but temporary plugging of the wound is always effective and allows subsequent control of the vessel.

Section of any arterial branches running upwards from the renal artery now frees the gland for removal.



Closure of wound

11 The abdominal wound is closed in layers. The peritoneum and posterior rectus sheath are sutured as one layer and suture of the anterior rectus sheath then brings the divided ends of the muscle together to allow firm union. Finally the skin is closed without any drainage



SPECIAL POST-OPERATIVE CARE AND COMPLICATIONS

Cortisone 100 mg must be given 6-hourly for several days and then the dose may be diminished or stopped altogether depending on the individual patient. Intravenous glucose may be valuable in the immediate post-operative period

Some weeks after the operation there may be a delayed reaction requiring more cortisone

Very rarely medullary failure may occur some weeks after operation, and this may be controlled by nor adrenaline drip 3 mg per 100 ml. regulating the flow as required.

The normal complications which may follow a laparotomy must be considered.

[The illustrations for this Chapter on Subtotal Adrenalectomy were drawn by Mr J Wheldon from originals by Dr Stella Henry]

TOTAL ADRENALECTOMY
USING LUMBAR INCISIONS

J SETON PRINGLE, F.R.C.S (I) AND (ENG.)
Professor of Surgery Royal College of Surgeons in Ireland

PRE-OPERATIVE

Indications

The administration of sex hormones has been found to influence the growth of some cancers of the prostate and breast and it has been known for a long time that orchidectomy commonly produces a striking retrogression both in the primary growth and in the metastasis, of carcinoma of the prostate

In the female oophorectomy has resulted in some improvement in carcinoma of the breast but unfortunately in only a small proportion of cases, and it is at present impossible to tell which cases will benefit by operation

After removal of the gonads the steroid hormones are still produced in the presence of the adrenals, and recently total adrenalectomy in association with the removal of the gonads has been tried for advanced cases of carcinoma of the breast and prostate with metastasis. In some cases of breast carcinoma the pain disappears rapidly from skeletal metastasis and the patient s general health improves, but other cases show no response and the operation is still on trial. Patients with metastasis in the lung do not appear to be suitable for operations.

Total adrenalectomy is also on trial at present for cases of malignant hypertension The operative mortality in these cases appears to be high, but some promising immediate results have been obtained. Recently total adrenalectomy has been suggested for Cushing s syndrome when there is no cortical tumour Both adrenals may be removed at one operation or they may be removed one at a time with an interval of 1–2 weeks between operations. Bilateral oophorectomy may be done at the first operation.

Access

The lumbar approach is described and it is commonly used at present. The abdominal approach is also satisfactory and is generally used if both adrenals are to be removed at the one operation. If the patient has metastasis in the spine or femur the lumbar position on the operating table may be dangerous and the abdominal operation is safer

Special pre-operative preparation

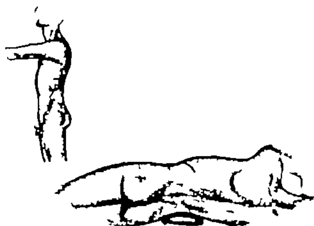
As a rule these patients are in poor general health and care must be given to normal pre-operative measures, and the extent of the malignant dissemination must be investigated Blood transfusions may be required, and the Thorn test for adreno-cortical function may be done.

In a staged operation cortisone is not required for the first side but at the second operation 100 mg should be given a day before operation and repeated an hour before operation

Position of patient

The patient is placed in the renal position but the renal bridge is placed about 8 inches above the lower costal margin

THE OPERATION



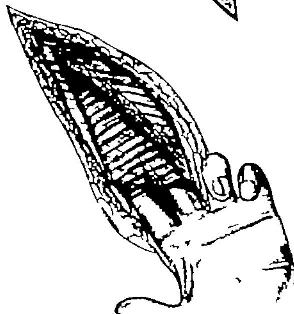
The Incision

1 The incision commences at the margin of the sacro-spinalis, over the twelfth rib and curves forwards between the last rib and the crest of the ileum for about 6 inches



Exposure of external oblique muscle

2 Deep to the skin and subcutaneous tissue the external oblique muscle is exposed, covered in the posterior part of the wound by the latissimus dorsi. Section of the lateral portions of the latissimus dorsi and the underlying serratus posterior inferior displays the posterior border of the external oblique, and behind this the internal oblique covering the lumbo-dorsal fascia. The external oblique is cut, exposing the internal oblique deep to it.



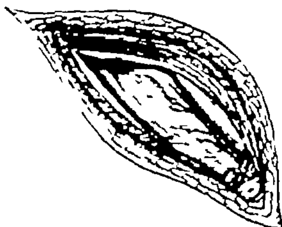
Exposure of internal oblique muscle

3 The internal oblique and lumbo-dorsi fascia are opened in the posterior part of the wound. The twelfth dorsal nerve and the subcostal vessels are seen crossing the posterior part of the wound deep to the lumbo-dorsal fascia and can sometimes be preserved, but are more usually cut. The incision in the lumbo-dorsal fascia at the edge of the quadratus lumborum allows extraperitoneal fat to extrude. A finger is shown slipped through this opening to separate the transversalis muscle and fascia from the peritoneum.

The internal oblique and transversalis can now be cut anteriorly without danger of damage to the peritoneum. The eleventh intercostal nerve and vessels lie between the internal oblique and transversalis muscle towards the front and may be cut in a long incision. A bilateral oophorectomy can be done by opening the peritoneum in front of the colon.

Separation of quadratus lumborum from edge of rib

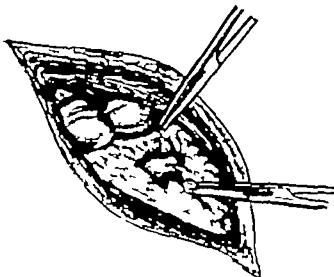
4 The twelfth rib can now be seen in the upper part of the incision. Adequate exposure can generally be obtained by separating the quadratus lumborum from the lower edge of the rib and dividing the external arcuate ligament. The subcostal vessels may be damaged at this stage and if their position close to the undersurface of the rib makes control of bleeding difficult, they can be understitched. Alternatively if a better exposure is required the twelfth rib can be removed. The pleura lies in relation to the medial part of the rib and must not be damaged



Opening the perirenal capsule

5 The retroperitoneal fat is now separated and thus exposes the perirenal fascia in the posterior part of the wound and the colon anteriorly. The perirenal capsule is opened between forceps to show the fatty capsule of the kidney. The anterior surface and upper pole of the kidney are separated from the perirenal capsule and the peritoneum. Normally the peritoneum strips easily but if it is adherent it may tear and should be sutured. If the suprarenal is not clearly seen it can be identified by palpation.

The further details of removal of the gland have already been described from the anterior approach

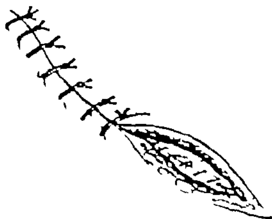


Closure

6 The muscles of the wound are closed in layers and the skin sutured.

Drainage

Drainage is generally unnecessary but if there has been undue bleeding during the deeper stage of the operation, it may be advisable to leave drainage down to the kidney bringing it out near the posterior end of the wound.



SPECIAL POST-OPERATIVE CARE

Most of the patients at present subjected to total adrenalectomy are in poor general condition and may require intravenous fluids or blood transfusions after operation.

Pathological fractures

If there are bone metastases the patients must be very carefully nursed, particularly in the recovery period, as pathological fractures can easily occur

Medullary failure

A very severe fall in blood pressure may occur from medullary insufficiency either in the immediate post operative period or sometimes after a latent period of several weeks. This complication is not common but can be controlled by a noradrenaline drip 2 mg per 100 ml.

Cortisone therapy

Cortisone 100 mg is given 6-hourly for the first 24 hours after operation, and the dose is gradually reduced during the next few days to a maintenance dose, which must be continued for the rest of the patient s life Cortisone, 25 mg daily is normally an adequate maintenance dose, but up to 50 mg may be required, and the patient must be warned that the dose may need to be increased following an accident or during intercurrent disease

Evidence of adrenal insufficiency such as low blood-pressure, diminished urinary output of high specific gravity or abdominal pain will be an indication for an increase in the dose of cortisone.

Extra salt may be added to the diet but this is generally unnecessary

When the removal is being done in two stages, no hormone therapy is required for the first operation.

[*The illustrations for this Chapter on Total Adrenalectomy were drawn by Mr J Wheldon from originals by Dr Stella Henry*]

INDEX

A

Abdominal aorta, exposure of vii, 71 72
Abscess,
    cervical, incision of, vi, 21
    cold, vi, 18
    parotid, drainage of, vi, 185, 141
Achilles tenotomy vii, 149
Adenoma, pituitary removal of, viii, 43
Adrenalectomy
    sub-total, viii, 57
    total, viii, 63
Adrenal gland, exposure and resection of viii, 1
Anastomosis,
    arterial, vii, 82
    Carrel's, vii, 82
Aneurysm,
    axillary artery of, vii, 125
    coarctation, vii, 123
    dissecting, vii, 121
    femoral artery vii, 125
    gluteal artery vii, 124
    lower abdominal aorta, vii, 118
    popliteal artery vii, 125
    thoracic aorta, of, vii, 123
    upper abdominal aorta, vii, 124
Ankle,
    exposure of saphenous vein at, vii, 89
    perforating veins of, ligation of, vii, 47
Anticoagulants, arterial suture and, vii, 87
Aorta,
    abdominal, exposure of, vii, 71 72
    saddle embolus of, vii, 89
    thoracic, aneurysm of, vii, 123
Aortic bifurcation, grafting of, vii, 97
Aortography vii, 109
Arm, post-operative lymphoedema of, vii, 188
Arterial aneurysms, vii, 115
Arteriography
    carotid, vii, 104
    cerebral, vii, 101
    femoral, vii, 102
    parathyroid gland exploration, in, viii, 27
    vertebral, vii, 118
Arteriosclerosis, diffuse, thrombo-endarterectomy for vii, 112
Artery
    diseased, suturing of, vii, 85
    grafting, vii, 93
    suture of, vii, 81
Ascending phlebography vii, 65
Autogenous vein graft, vii, 95
Axillary artery
    aneurysm of vii, 125
    exposure of vii 67
Axillary lymph nodes, excision of vi 5

B

Blalock arterial suture vii, 8
Block dissection of lymph glands, radical thyroidectomy in viii, 16
Bone grafts, excision of dental tumours, in, vi, 161
Brachial artery exposure of vii, 69
Brachial plexus, exposure of cervical rib removal in, vi, 57
Branchial cyst, vi, 31

C

Calculus, submaxillary duct, intra-oral removal, vi, 147
Canthus, dermoid cyst of, vi, 8
Carotid arteriography vii, 104
Carotid artery identification, carotid arteriography in, vii, 104
Carotid body tumour removal of, vi, 89
Carotid sheath exposure of, vi, 41
Carrel's anastomosis, vii, 82
Cavernous haemangioma, tongue of, vi, 17
Cerebral arteriography vii, 101
Cervical abscess, incision of vi, 21
Cervical lymph nodes,
    block dissection of, vi, 72
        glomectomy in, vi, 191
        partial pharyngectomy in, vi, 61
    tuberculous, vi, 18
Cervical rib vi, 54
Cervical sinus, vi, 84
Coarctation aneurysm, vii, 123
Cold abscess, cervical vi, 18
Common carotid artery exposure of, vii, 69
Common facial vein, division of, cervical lymph node dissection in, vi, 29
Common femoral artery
    embolus of, vii, 90
    exposure of, vii, 75
Common iliac artery exposure of, vii, 78
Congenital arterio-venous fistulas, vii, 111
Conservative parotidectomy vi, 185
Cyst,
    branchial, vi, 84
    dental, vi, 156
    dermoid, excision of, vi, 8
    sebaceous, excision of vi, 5
    sub-mental dermoid, vi, 80

[Roman numerals refer to Part number]

Cyst (cont)
thyroglossal, excision of, VIII, 22
tubulo-dermoid, of tongue, VI, 154
Cystic hygroma, VI, 26

D

Deep vein ligation, VII, 57
Dental cysts and tumours, VI, 156
Dermoid cyst,
excision of, VI, 8
floor of mouth, of, VI, 152
Descending phlebography VII, 56
Diaphragm, exposure of, adrenalectomy in, VIII, 38
Diodrast, phlebography in, VII, 55
Diseased artery suture of, VII, 85
Dissecting aneurysms, VII, 124

E

Embolectomy VII, 88
Endo-aneurysmorrhaphy VII, 115
Everting suture, arterial suture, in, VII, 84
External carotid artery exposure of, VII, 71
External iliac artery exposure of, VII, 74

F

Femoral artery aneurysm, VII, 125
Fibroma, tongue, of, VI, 155
Floor of mouth, excision of VI, 122

G

Glabella, dermoid cyst of, VI, 8
Glossectomy VI, 118
Gluteal aneurysms, VII, 124
Grafts, artery or vein, VII, 93

H

Haemangioma, cavernous, of tongue VI, 155
Hemi-glossectomy VI, 119
Hemi-mandibulectomy VI, 110
Hemi-thyroidectomy VIII, 18
Heparin, embolectomy and, VII, 91
Hypopharynx,
carcinoma of, VI, 60
mobilization of, VI, 64
Hypophysectomy VIII, 40
Hypothermia, major blood vessel surgery in, VII, 64

I

Idiopathic lymphoedema, VII, 138
Ilio-femoral junction, exposure of VII, 6
Infants, dermoid cyst in, VI, 8
Inferior cervical ganglion block, VII, 6
Inferior parathyroid glands, exposure of, VIII, 29
Inferior vena cava ligation, VII, 61
Inguinal lymph nodes, excision of, VI, 85
Innominate artery exposure of, VII, 65
Intermittent claudication, achilles tenotomy for, VII, 142
Internal carotid artery exposure of, VII, 71
Interrupted suture, arterial suture, in, VII, 84

L

Laryngo-oesophago-pharyngectomy VI, 63
Laryngo-partial pharyngectomy VI, 68
Laryngo-pharyngectomy VI, 63
Lateral rhinotomy maxillary carcinoma, in, VI, 105
Leg, lymphoedema of, VII, 138
Lingual artery ligation of,
hemiglossectomy in, VI, 119
total glossectomy in, VI, 120
Lingual thyroid, excision of, VIII, 22
Lip, epithelioma of, VI, 128
Lower abdominal aorta, aneurysm of, VII, 118
Lumbar ganglion block, VII, 7
Lumbar sympathetic ganglionectomy VII, 28
Lumbodorsal sympathectomy VII 20
Lymphadenitis, tuberculous cervical, VI, 18
Lymphangioma, tongue, of, VI, 155
Lymph nodes,
axillary excision of, VI, 85
block dissection, VIII, 16
inguinal, excision of, VI, 85

M

Major blood vessels, grafting of, VII, 93
Mandible, excision of, VI, 108
glossectomy and, VI, 125
Mattress suture, arterial suture, in, VII, 81
Maxilla, excision of, VI, 94
Mouth,
carcinoma of, VI, 117
dermoid cyst of, VI, 152

N

Neo-Hydriol, sialography in, VI, 131

O

Oropharynx,
carcinoma of, VI, 50
mobilization of, VI, 61
Osteoma of vault, excision of, VI, 14

P

Palatal fenestration, carcinoma of maxilla, in, VI, 10?
Papilloma, tongue, of, VI, 155
Parathyroid glands, exploration of, VIII, 27
Parotid abscess, drainage of, VI, 144
Parotid duct orifice enlargement of, VI, 143
Parotid gland, operations on, VI, 135

[Roman numerals refer to Part number]

Parotid sialogram, VI, 181 182
Partial glossectomy VI, 118
Partial glosso-pharyngectomy VI, 69
Partial palato-pharyngectomy VI, 62
Partial pharyngectomy VI, 61
Pedunculated lipoma, tongue of VI, 1..
Pharyngeal pouch, excision of, VI, 43
Pharynx, carcinoma of, VI, 70
Phlebography VII, 51
Pinna, excision of, VI, 11
Pituitary gland,
  exposure of, VIII, 80
  interstitial irradiation of VIII, 47
Pleura, exposure of, adrenalectomy in, VIII, 59
Polythene, arterial aneurysm reinforcement, in, VII, 11
Polyvinyl bar mandibulectomy use in, VI, 111
Popliteal artery
  aneurysm of, VII, 125
  embolus of, VII, 91
    aortic grafting followed by VII, 100
  exposure of, VII, 78
Posterior splanchnic block, VII, 7
Posterior tibial artery exposure of VII, 79
Post-phlebitic syndrome VII, 47
Presacral neurectomy VII, 20 26

R

Radical parotidectomy VI, 18
Radical thyroidectomy VIII, 13
Radio-active yttrium in pituitary destruction, VIII, 47
Rathke's pouch tumour removal of VIII, 44
Recurrent laryngeal nerve,
  dissection of, hemithyroidectomy in, VIII, 19
  exposure of, subtotal thyroidectomy in, VIII, 9
Resection enucleation of thyroid adenoma, VIII, 18
Retrocondylar vein, ligation of, conservative parotidectomy in, VI, 189
Retrosternal goitre cervical approach to VIII, 18

S

Saddle embolus of aorta, VII, 89
Saphenous vein,
  exposure at ankle, VII 89
  ligation, varicose vein stripping, in, VII, 87
  mobilization, varicose vein stripping, in, VII 86
Scarpa's fascia, division of, varicose vein stripping, in, VII, 86
Sclerosants, varicose veins, in VII, 42
Senile lipoma, tongue, of VI, 156
Sialography
  parotid, VI, 182
  submandibular VI, 183
Soft palate, removal of, maxillary carcinoma, in, VI, 36
Stellate ganglion block, VII, 6
Sternotomy thymectomy in, VIII, 83
Subclavian artery exposure of,
  cervical rib removal, in, VI, 57
  first part, VII, 65
  third part, VII, 66
Subcutaneous lymphoedema, excision for VII, 138
Submandibular incision subperiosteal excision of dental tumours in, VI 16?
Submandibular sialogram, VI 183
Submaxillary duct calculus, intra-oral removal, VI 17?
Submaxillary gland, excision of VI, 119
Sub-mental dermoid cyst, VI 70
Sub-mental region, cyst of, VI, 153
Subtotal adrenalectomy VIII, 77
Subtotal thyroidectomy VIII, 5
Superficial femoral artery exposure of VII, 77
Superior parathyroid glands, exposure of VIII, 28
Supra-renal gland, exposure of, subtotal adrenalectomy in VIII, 58
Suprasellar meningioma, removal of VIII, 44
Suture arterial, VII 81
Sympathetic ganglion block, VII, 5
Sympathetic ganglionectomy
  lumbar VII, 24
  lumbar dorsal, VII, 20
  upper thoracic, VII, 8

T

Thoracic aorta, aneurysm of, VII, 123
Thrombo-endarterectomy VII, 111
  lateral suture for VII, 82
Thrombosis, femoral arterial, arteriography in, VII, 103
Thymectomy VIII, 83
Thyroglossal cyst, excision of, VIII, 22
Thyroid adenoma, resection enucleation of, VIII, 18
Thyroid gland, mobilization of, pharyngeal pouch excision, in VI, 45
Thyroidectomy
  radical, VIII, 13
  subtotal, VIII, 5
Tongue
  carcinoma of, VI, 117
  papilloma of, VI, 155
  tubulo-dermoid cyst of, VI, 154
Total adrenalectomy VIII, 63
Total glossectomy VI, 120
Trachea, division of,
  carcinoma of hypopharynx, in, VI, 64
  laryngo-partial pharyngectomy in, VI, 68
Tracheostomy VI, 49
  carcinoma of hypopharynx, in, VI, 64
  laryngo-partial pharyngectomy in, VI, 68
Transpleural thymectomy VIII, 88
Trans-sternal thymectomy VIII, 83
Tuberculous cervical lymphadenitis, VI, 18
Tubulo-dermoid cyst, tongue, of, VI, 154

U

Upper abdominal aneurysm, VII, 124
Upper thoracic ganglion block, VII, 6
Upper thoracic sympathetic ganglionectomy VII, 8

[Roman numerals refer to Part number]